NATURE STUDY

AND

SCHOOL GARDENING

FOR

ELEMENTARY SCHOOLS

BY

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AND

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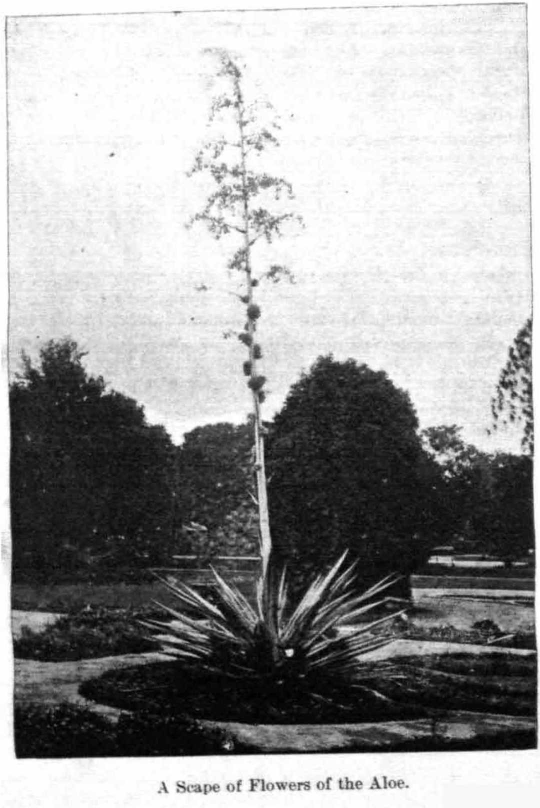

A Scape of Flowers of the Aloe.

PREFACE

This book is divided into two parts. Part I deals with the recognition, observation and description of familiar natural phenomena and plant and animal life of the Madras Presidency, and is intended as a course of nature study for Standards I to III in elementary schools. Part II is concerned with school gardening, and is intended for use in classes above Standard III.

At present the study of plant life in elementary schools consists largely of the observation of the parts of plants and their uses, done within the class-room. The aim of Part I of this book is first to take the child out of the class-room and to place him in direct touch with nature, both in the school garden and outside it. In the second place, Part I contains a general, popular account of common plants and animals, the aim being to enable the pupil to recognise, observe and describe the common living things around him. It is considered that such method of treatment is likely to have a greater attraction and interest for young children than the meticulous, pseudo-scientific study of the parts of a few living things.

Perhaps the most profitable nature study for children, after they are able to recognise things in nature, is the study of the life-history of plants and animals. While in Part I the life-histories of certain insects are described, it has not been possible to give such life-histories throughout. It may be possible to do more in this direction in a future edition. In the meanwhile it is hoped that the teacher will, with his pupils, take up the study of the life-history of typical plants, such as the bean, bende, chilli, brinjal, etc. A study of the life-history of trees is not so easy, but even here the teacher should be on the look-out for trees in different stages of growth, and should lead the pupils to observe their development and the differences seen at different stages.

Part II contains instructions on the cultivation of vegetables, flowers and fruits. Up to the present, nature study in the higher standards of elementary schools has been concerned largely with the rudiments of scientific botany, which tends to lead the pupil away from nature. School gardening,

on the other hand, keeps him in close and continuous touch with the plant life of his surroundings. Gardening is thus an excellent means of nature study. It also has the advantage that it affords exercise in the use of tools. Learning by seeing and doing is the best kind of learning, and there are few, if any, subjects in rural elementary schools where this double educational purpose can be so well served as in school gardening.

The utilitarian value of school gardening is obvious. The gardens attached to most Indian households are not systematically cultivated, owing partly to the want of knowledge of the householder. The aim of this book is to supply this knowledge; in Part II is described what are believed to be the best methods of cultivating common vegetables, flowers and fruits. It is hoped that this book will have the effect of turning the attention of future householders to gardening as an interesting and profitable occupation.

In this connection, school managements and teachers are reminded that, in a rural school with adequate garden-space, gardening is one of the most appropriate and profitable forms of vocational training. Part II of this book enables a start to be made in this direction. It shows the pupil how to get full value out of his garden by adopting systematic methods of cultivation, and by introducing varieties of vegetables, flowers and fruits not hitherto grown in his village.

H. CHAMPION.

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NATURE STUDY AND SCHOOL GARDENING FOR ELEMENTARY SCHOOLS.

CHAPTER 1.—SYLLABUS OF STUDY.

The following syllabus is intended to help the teacher in framing a course of instruction for each standard in the elementary school. The syllabus is based upon the contents of the book.

It is not intended that all the items included in the syllabus should be included in the syllabus of every school. The first essential is that nature study in the elementary school should be a study of nature itself, and not a second-hand study of nature from a text-book. Only such plants, therefore, as are found in the locality of the school should be taken up for study and included in the school syllabus.

The distribution of plants among the various elementary school standards, as shown in the following syllabus, is not intended to be rigorously followed. For instance, Standard I may be taken out for a walk to study the Datura: in the course of this walk, they may see a Mexican Poppy, and may call the teacher's attention to it. The teacher should not say that the Mexican Poppy is intended for study in Standard II: he should respond to the children's curiosity, and should immediately lead them to a study of the Mexican Poppy appropriate to the age and progress of the pupils. Every effort should be made to arouse a spirit of enquiry and curiosity in the children, and the syllabus should not be allowed to stifle this spirit.

Following the syllabus is a table showing the seasons in which the various plants may most profitably be studied. This table does not apply to all parts of the Presidency: the seasonal activities of trees, plants and animals vary in different tracts, and it is for the teacher to prepare a table showing the seasonal distribution of study suited to his particular school.

Syllabus of study.

Topics.	Standard I.	Standard II.	Standard III.	Standard IV.	Standard V.	Standard VI.
. Trees	Portia. Margosa. Tamarind. Gold mohur. Coconut. Palmyra.	Mango. Babool. Korakapuli. Nona. Nagai. Rain-tree.	Banyan. Peepul. Wood apple. Bamboo. Pungan. Vagai or Usilai.	Jack. Cashew nut. Iluppai. Elandai. Kiluvai or other trees found in the locality.	Work in the school garden.	
2. Shrubs and weeds.	Datura. Madar. Jatropha.	Mexican poppy. Neronji. Tumbe.	Aloe. Cactus. Grasses. Any five weeds.	6 or 7 common weeds.	As Standard IV. The removal of weeds.	Cultivation of perennial flowers and fruits.
3. Vegetables ...	Plantain. Brinjal. Chilli. Bende. Lab lab. Agathi.	Cluster bean. Gourds. Amarantus. Coriander.	Onion. Radish. Ginger. Sweet potato. Drumstick.	Work in the garden.	Work in the garden. Manures and manuring. Rotation of crops. Nurseries and transplanting.	
4. Flowers	Rose. Jasmine. Oleander. Shoe-flower.	Vinca Rosea. Parijatam. Thangarali. Konnai.	Rangoon creeper. Tulsi. Sun flower. Chrysanthemum.	Work in the garden.		
5. Fruits	Guava. Lemons.	Pomegranate. Custard apple.	Pappay.	......	......	

6. Natural Phenomena.	Rain (1 and 2). Sun and moon (1).	Rain (3). Wind (1). Clouds (1). Sun and moon. Revision (1).	Rain (4 and 5). Wind (2). Clouds (2). Sun and moon (2).	The soil. Measurement of rainfall. Maintaining school weather chart. Sun (3).
7. Animals and Insects.	Cow, horse, sheep, goat, cat, dog, fowl and crow. Grasshopper. Butterflies.	Squirrel, lizard, blood-sucker, kite, sparrow, mynah, drongo, moths, beetles.	Snakes, frogs, fishes, snails, earth worm. Pigeon, hoopoe, bee eater, honey sucker, king-fisher. Dragon fly, life-histories of frog, butterfly, moth and beetle.	Paddy bird, cattle egret, woodpecker and other common birds. Weevils, bees, ants, house fly, mosquito, bugs, life-history of insects in general. Insect pests.

Suggested seasonal distribution of study.

January to February.	March to April.	May to June.	July to August.	September to October.	November to Decemter.
Tamarind in fruit. Mango in flower. Korakapuli in flower. Babool in fruit. Lab-lab. Ginger. Shoe-flower. Grasses.	Palmyra in flower. Margosa in flower. Korakapuli in fruit. Lemon in flower. Custard apple in flower. Sweet potato. Coriander. Jasmine. Rangoon creeper. Drongo, Mynah. Butterflies and moths.	Palmyra in fruit. Lemons in fruit. Tamarind in flower. Mango in fruit. Gold mohur in flower. Mexican poppy. (*N.B.*—Allowance should be made for the vacation during this period.)	Margosa in fruit. Babool in flower. Nagai in fruit. Custard apple in fruit. Preparation of the school garden. Oleander. Parijatam. Tailor bird. Kingfisher.	Wood apple in fruit. Gold mohur in fruit. Amarantus. Brinjal. Chilli. Frogs and snails. Beetles and bugs.	Drumstick. Agathi. Gourds. Onion. Bende. Rose. Chrysanthemum. Paddy bird. Blue jay. Dragon flies. Earth worm.

PART I.—NATURE STUDY.

Chapter 2.—TREES.

The Margosa (Vembu).

This is a very common tree in every village. Children have seen margosa leaves kept in houses when smallpox and other epidemic diseases are prevalent. They know that the flowers are made into a "pachadi" on New Year's Day. They also probably know that margosa oil is used medicinally, and are acquainted with its nauseating smell.

Question the children on the above points and encourage them to say what they know about it. Show them the tree and point out that it has big branches and plenty of lovely green foliage. Pluck a branch of leaves and show to the children. Let them note the small, narrow, tapering leaves with serrated margin, and how they are arranged in pairs on the stalk. What peculiarity do they note regarding the young leaves at the ends of twigs? They are reddish brown in colour, and they become green as they grow. Ask them to munch one leaf and note the characteristic bitter taste.

Draw their attention to the perfect white flowers found in clusters. Let them smell and note the fragrance. Ask them if they find the flowers all the year through. They know that the flowers are to be had only at the time of the New Year. Tell them that there are particular seasons for flowering and fruiting, which they will have to observe for themselves.

Show them the oval fruits which are green in colour; they turn yellow when ripe. Let them see the seed inside within the small pulpy matter. Elicit that crows eat these fruits and cast out the hard seeds. Tell them that the seeds are carried to distant and out-of-the-way places in this manner and that from these seeds margosa trees grow.

Question the children and let them give the uses of the tree. It gives fine shade and hence is planted along the road-side. It yields good timber; the wood being bitter is proof against white ants. Margosa oil is used medicinally and the oil-cake is a good manure. Tell them how the atmosphere of the margosa tree is considered to be healthy.

The Babool (Karuvelaṇ)

This is a common tree growing wild and is easily recognized by the thorns, very small leaves, dark coloured bark, and the fruits which are like strings of beads.

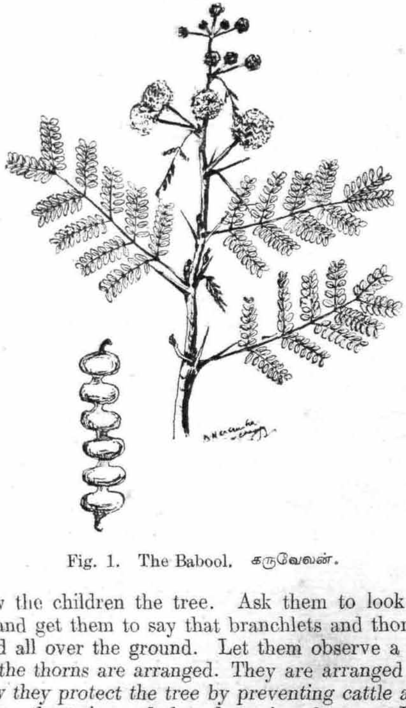

Fig. 1. The Babool. கருவேலன்.

Show the children the tree. Ask them to look beneath the tree and get them to say that branchlets and thorny twigs are found all over the ground. Let them observe a twig and say how the thorns are arranged. They are arranged in pairs. *Show how they protect the tree by preventing cattle and goats* from eating the twigs and thus damaging the tree. However, goats are fond of the leaves, which they nibble carefully so as not to come in contact with the thorns.

Draw their attention to the bark which is dark and sometimes even black. The branches also are of this colour. Tell them why this is called Karuvelan. There is another variety whose trunk is white or yellowish and is called Velvelan.

(white Velan). Show them the Velvelan if there is one near the school.

Let them look at the tiny leaves arranged in pairs on a stalk. Show them the bright yellow balls of flowers on the tree. Let them examine a ball and find out that each ball is composed of a number of small flowers.

Give them some fruits and let them feel them. They are long, white and velvety. Cattle and goats eat the fruits. Show them the black, round and flat seeds.

Tell them how the tree is distributed in nature by sheep and goats through their droppings.

Tell them the uses of the tree. It yields very good timber. Its bark and pods are used in tanning. Its gum is very useful.

The Tamarind (Puli).

This tree is found everywhere. It is often planted on road-sides to serve the double purpose of giving shade and yielding fruits. It is a popular belief that the shade of the tamarind tree is hot and causes eye diseases. There are people who believe that the tree is the abode of devils and evil spirits, and that the neem tree has the power of driving away evil spirits. If the children have such ideas, the teacher should point out that they are the result of ignorance and superstition, and that all trees grow for the good of man.

There is no child who does not take tamarind daily with his food. They all know the sour fruits of the tree.

Show them the tree. Such a big tree has grown from the small seed! Tell them there are bigger trees which grow from smaller seeds, e.g., the banyan. Children can recognise the small leaves arranged in pairs. Let the children note the sour taste of the leaves; probably they know this already.

Show them the pink flower-buds and the yellow flowers. Ask them if the flowers are seen all through the year. No, they are seen only in some months; similarly, the fruits are had in some months only. Which months? Let the children observe and note.

Let them examine the fruits. There is the hard shell outside and the pulpy matter inside. They readily recognise the brown, flat seeds.

The tree yields good timber and fuel.

The Portia (Puvaṛasu).

This is a common avenue tree planted on road-sides and village maidans to give shade (particularly in "Kavalai" ramps).

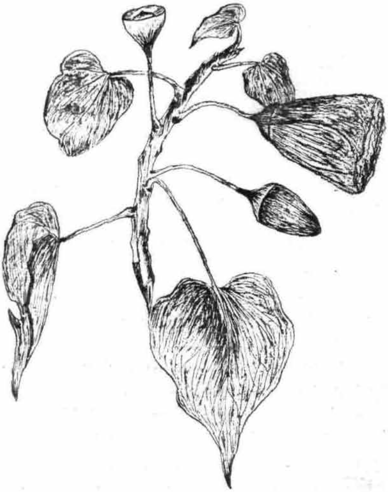

Fig. 2. The Portia. பூவரசு.

Show them a tree. The children are attracted by the large yellow flowers. Ask them if they know of similar flowers. They may suggest the bende or cotton if they are acquainted with these. Let them note the fine large petals and the crimson centre. How are the stamens arranged? They are arranged on a sheath-like tube in the centre. Show them the small embryo fruit inside the flower. Draw their attention to the cup-like calyx. Cut open the fruit and show the numerous seeds. Tell them that seeds are not used to grow portia trees, but fairly thick branches are cut and planted which take root and grow.

Pluck a twig on which there are leaves and show the large, wide-pointed leaves. Ask the pupils why some leaves are brown or yellow in colour. Green leaves change to

brown or yellow before falling down. Some people use the leaves for taking food on.

The tree yields good timber, but it is chiefly grown for its shade. What other trees give good shade? Recapitulate previous lessons.

The Coconut Palm.

All children are acquainted with palm trees, but they may not be able to distinguish one kind of palm from another unless they see the fruits. The common palm trees are the coconut, the palmyra, the areca and the wild date.

Show the coconut palm. What peculiarity do they note about this tree? It has no branches, but has one tall trunk with a tuft of leaves at the top. Let the pupils mention other branchless trees. Show these trees if possible.

Draw attention to the height of the tree: if 10 to 15 men stand one over the other, with the feet of one upon the head of the other, probably the topmost man would reach the top of the tree.

Point out the number of rings that are seen throughout the length of the trunk, and show the pupils how these are the scars of fallen leaves. Let them study the large leaves. What are they like? They are like large feathers.

Show them the roots exposed to the surface of the ground. What difference do they note between these roots and the roots of other trees such as the margosa and the tamarind? These roots are thin and numerous, whereas the roots of other trees are very big and branching.

Get a spathe of flowers from a toddy-drawer, cut it open, and show the children the spike of numerous flowers. Let them suggest the use of the spathe to the flowers. Draw their attention to the numerous small flowers at the top of each branch and the few embryo fruits at the bottom. Tell them that both kinds are really flowers, but that those at the bottom develop into fruits.

Lead the children to talk of the uses of this most useful tree. Coconuts are eaten; oil is pressed out of the copra; oil-cake forms food for cattle and also good manure; the stem is used as beams and rafters; the fibre is twisted into ropes; and the leaves are used for thatching.

Toddy is extracted from the flower spathes. Elicit that ne children have seen toddy-drawers climbing the trees in the

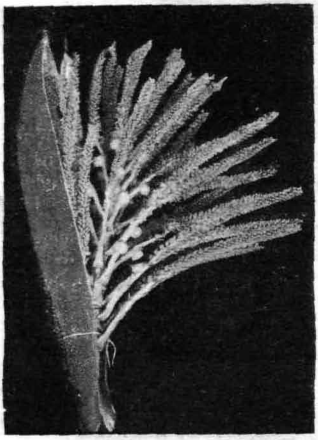

Fig. 3. A spathe of coconut flowers.

morning and evening to collect toddy. If there is any drunkenness in the locality, impress upon the children the evils of this vice.

The Palmyra Palm.

Take the children out and show them a palmyra palm.

Ask them in what respects this resembles the coconut. What differences do they note between this trunk and that of the coconut? The trunk of this tree is dark and rough, but that of the coconut is grey and smooth.

Draw attention to the leaves which are fan-shaped and cut in the margin only. The sides of the leaf stalk are spiny. Let them give the differences between these leaves and those of the coconut palm.

Show them the fruits. They have eaten the jelly-like kernel inside known as "nungu". Ask them when "nungus" are sold in the streets. Are they sold all the year through?

They are to be had only in the hot season (April to June). Can they get coconuts all through the year? Yes, coconuts ripen throughout the year.

Cut a palmyra fruit across, and show them the three compartments with a seed or nut in each. When the seed ripens there is the hard shell covering it. Let them say how many nuts are found in the coconut.

Let them observe the thin and numerous roots of the tree, and elicit that they are like the roots of the coconut.

Encourage them to talk about the uses of the palmyra. Its trunk is used as beams and rafters; the leaves are used for thatching; the fruits are eaten, also the radicle of the seedlings; toddy is extracted; jaggery is made from the sweet juice got from the flower spikes.

N.B.—Information regarding the fruiting flowers (pistillate) and the non-fruiting flowers (staminate), and how each tree produces only one of these, or how certain trees only produce fruits, should be told to the children in a simple way. Probably children know that certain trees do not produce fruits.

The Areca Palm.

This is common in some places, and may be dealt with in the same way as the coconut and palmyra palm. The areca palm has a particularly graceful, slender and ringed stem. The feathery tuft of leaves is beautiful. (See Fig. 5.)

The Wild Date.

This is easily recognised by the large scales on the trunk and by the masses of bright orange-coloured little date fruits. The leaves are used for making mats. Toddy is extracted from this also, but not from the areca palm.

The Banyan (Alai).

Take the children to a banyan tree, which is found on road-sides and river banks. Ask them what *striking feature they note about the tree. Roots are given off from the branches, and hang down in the air.* Show them some of the roots which have reached the ground and penetrated into the surface. Let them suggest the purpose served by such aerial roots. They get into the soil and serve as regular roots to

supply the tree and the branches with food. Show them the large, wide-spreading branches going a long way from the main

Fig. 4. A group of palms.

trunk. Tell the children that these aerial roots support the branches which would break but for these roots. Let them learn how the tree protects itself and its branches. If a full-grown tree is available, show them how these roots become as

Fig. 5. Arecanut tope.

large as the main trunk. Tell them there are some very old trees with a large number of stout aerial roots which serve the purpose of columns and pillars of a large shamiana; and in their shade there is space enough for a village.

Let the children examine the leaves and note they are large, thick, elliptic in shape and downy on the under-side.

Pluck a leaf or a small twig. What do they note? A kind of milky juice oozes out. Draw their attention to the leaf buds, protected by a sheathing scale which drops down as the leaves grow. Let them note the different colours of the young leaf, the full-grown leaf and the falling leaf.

Show them the fruits which are green when young, and red when ripe. Cut open a fruit. What do they see inside? A number of seeds are inside in the midst of what looks like little insects.

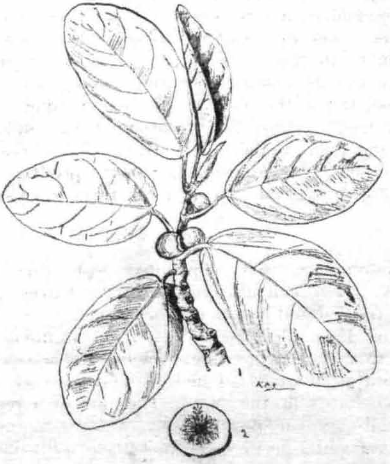

Fig. 6. The Banyan. ஆலை.
1. A twig.
2. Section of fruit.

Ask them to search for the flowers. They may tell you that flowers do not grow on the banyan. Do they know the proverb " அத்திபூத்தாப்போல் "? Tell them it is popularly believed that the banyan, peepul and country fig have no flowers. But the fact is that the small seed-like things and the processes are really flowers enclosed in a cup, which is popularly known as the fruit. The fruits are really the seeds inside this cup. Let them observe if banyan fruits are to be had all the year through.

Lead the children to talk about the uses of the banyan—it gives fine shade; its leaves and fruits are eaten by goats; the leaves are also used by many people for taking food on; the aerial roots are used to clean the teeth.

Similarly deal with the peepul, Ficus glomerata (Atti) and the jack tree.

The furits and leaves of the peepul are eaten by cattle and goats. The unripe fruits of the country fig are cooked and eaten.

The jack fruits are fine in appearance and eaten by all. Show the children the two kinds of flowers which are found on the trees. Let the children compare the jack tree with the palmyra in this respect. In the case of the jack the staminate and the pistillate (fruiting) flowers are found in the same tree, but in the case of the palmyra they are found in different trees. Draw the attention of the children to the flowers and fruits found on the trunk of the tree, even very near the roots. Explain to them how the proverb " வேண்டுமானால் வேரிலும் காய்க்கும் " originated from the jack tree.

The Mango (Ma).

Children are well acquainted with ripe and unripe mangoes. They can also recognise the leaves, as they are used on festival and ceremonial occasions.

Show them the tree. Let them examine the leaves and feel them. They are thick, smooth and somewhat shining. Draw their attention to a bunch of tender leaves if available. What peculiarity do they note? They are of a reddish brown colour and they hang down loosely, whereas the mature leaves assume horizontal positions. Show them the yellowish brown leaves which have fallen to the ground.

Draw their attention to the clusters of flowers. Let them note the fragrance What do they find on the trees and the flowers? Numerous ants and insects visit the flowers. On the mango trees we generally find ants, especially the red ants whose bite is very painful. Ask them why these visit the flowers.

The children know the fruit, and they can easily describe it. It contains a fleshy, tasteful pulp under the strong, leathery skin. Inside the pulp is the seed or nut, which is fibrous in some fruits. These fibrous fruits are troublesome to eat. Draw their attention to beetles or weevils boring into the fruit and seed, and elicit how these spoil the fruits and seeds.

The tree is planted on road-sides to serve the double purpose of giving shade and fruits. Reference may be made to the different kinds of fruits, as the mulgoa, peether, dilpasandu and so on. Ask them if mangoes are to be had all through the year. Let them say when they are to be obtained.

Fig. 7. The Cashew nut.

Similarly the cashew nut tree may be studied if found in he locality. What is generally called the fruit is the swollen

fruit-stalk which bears the fruit popularly known as the nut. The seed inside the hard case is well known to children.

The Rain-tree (Thungumoonji).

This tree, with its spreading branches, is now common everywhere. It is planted along road-sides to give shade, for it grows very rapidly.

Fig. 8. The Rain-tree. தூங்குமூஞ்சி.

Show the children the tree. Draw their attention to the trunk with furrows. The spreading branches give something of the appearance of an umbrella. Let them look at the leaves and observe how they are arranged. Can they suggest other trees with similar leaves? The tamarind has similar leaves, but they are smaller. Cattle and goats eat the leaves.

Show them the flowers. How are they arranged? What do they look like? They are arranged in small heads and look like pink or crimson silk tassels. Tell them a number of flowers compose the head. Have they seen any other tree with such heads of flowers? The babool.

Show them the fruits. Let them note that they are similar to the tamarind fruits, but have no hard shell covering

them. Let them break open a fruit and see the pulpy matter and the seeds inside.

Talk to them about the uses of the tree. It is chiefly grown for its shade. It yields fuel. Its timber is not useful

Pithecolobium dulce (Korakapuli).

This is a familiar small tree grown as a hedge in gardens and fields. Boys probably have eaten the fruits and they know the tree. It is also called "Konapuli" in some places.

Fig. 9. The Korakapuli. கொறுக்காப்புளி or கோணைப்புளி.

Show the children the tree. Do they note anything striking in the trunk? The trunk is crooked and ill-grown, and has horizontal weals all over it.

Carefully pluck a branch or twig and show the children. Let them see the leaves. What do they look like? They are small and in pairs; they are somewhat similar to the hoofs of a cow or goat, each leaflet being fairly straight along one edge and curved along the other. Let them feel the twig. What do they note? There are small thorns in pairs at the base of each leaf. Let them compare this with the babool.

Draw attention to the yellowish, woolly heads of flowers. Have they seen similar flowers before? The babool. Show

them how each head consists, as in the babool, of numerous little flowers. Tell them this belongs to the same family as the babool.

Get some fruits and let the children note how they twist into rings. Show them the black seeds inside. Talk to them of crows carrying away the fruits to eat the pulpy matter inside. The seeds are thus taken far away and new plants grow in different places.

The tree yields good fuel.

The Divi-divi or Konakkai.

This tree may similarly be studied if found in the neighbourhood. The trunk is short and of irregular shape. The

Fig. 10. The Divi-divi.

small, yellow flowers scent the air round the tree. The brown fruit is curiously shaped, forming half-circles and double half-circles assuming roughly the form of S. Elicit all these facts. The fruit-pods are of much value and are used for tanning leather.

Morinda tinctoria (Nona).

This is a small tree growing wild everywhere, and is easily recognised by the deeply cracked light-brown bark.

Show the children the tree, and let them note the characteristic cracked bark. Ask them to observe the leaves,

Fig. 11. *Morinda tinctoria* (Nona). நுணா.

which are long and narrow. Let them give the differences between this leaf and the mango leaf.

Show them the small, white, sweet-smelling flowers. Ask them to note the fragrance as they approach the tree. Can they suggest any other flower which gives a similar smell? They would suggest the jasmine. This is popularly called the sister of the jasmine. Let them note the differences between this flower and the jasmine. This flower is thicker and the underside is greenish. We do not use the flowers.

Let them observe the fruits. Cut open a fruit and show them. The fruit is irregular in shape, and is a conglomeration of several fruits or compartments. There are dark green lines dividing the fruit into compartments, and the compartmental centre is marked by a little dot or scar. Explain to them what this scar is.

The bark is sometimes used for dyeing: it produces a red dye.

The Bamboo (Moongil).

This gigantic grass is fairly common in villages.

Show the children a clump of the bamboo. Let them observe the tall, hollow, round bamboos with numerous

joints. Show them a section of a bamboo. Draw their attention to the thorns on the joints.

Let the children observe the linear and lanceolate leaves and the downy sheaths. Show how the leaves are like leaves of grass. Tell them the bamboo is a gigantic grass.

Show them the flower-spikes if available, and draw attention to their resemblance to the flower-spikes of grasses.

Let them observe the underground stems from which fresh shoots spring. Tell them how the plant is propagated from the seeds and underground stems. The bamboo flowers periodically at long intervals.

Talk to them about the use of the bamboo and how its strength and lightness make it so useful. It is used in building houses, forming rafts, making mats and tatties and in a thousand other ways.

Eugenia jambolina (Nagai or Noval).

This is a fine-looking, large tree, easily recognised by its white trunk and the drooping ovate leaves.

Fig. 12. *Eugenia jambolina* (Indian Plum). நாவை.

Show the children the tree. Pluck a twig and let them examine the leaves, which are dark-green, ovate, fairly thick and drooping. Let them crush the leaves and note the pleasant odour.

Get a bunch of flowers. They grow in clusters, and are greenish white and fragrant.

The children have eaten the fruits, and they readily recognize the dark crimson, or almost black, ripe fruits. They also know the hard seed inside. The seed sprouts quickly like the seed of the margosa. Ask them if the fruits are procurable all through the year. They know the fruits are to be had only during some months, during the months when Vinayakachathurthi and Sarasvathipuja occur. Thus elicit that the tree fruits from July to September.

The tree gives good shade owing to its dense foliage, and yields good timber.

An allied small tree, rarely met with, is *Eugenia Jambos*, which yields the fruit known as Jambu Nagai sold in the market.

Zizyphus jujuba (Elandai).

This is a small tree occasionally found in villages, and easily recognised by the circular or ovate small leaves and the thorns. (See Fig. 13.)

Show the children the tree and let them note the rough trunk. How do the branches grow, vertically or horizontally? The branches grow drooping down and they do not usually spread horizontally. This makes it easier for the boys to pluck the fruits.

Let them observe the small leaves which are about the size of a quarter-anna coin. Let them touch and feel the leaves. What do they note? The upper surface is glossy, whereas the under surface bears a whitish down and is soft.

Draw attention to the very small, yellowish and fragrant flowers growing in clusters.

They know the fruit, which is green when unripe, and which turns yellow and orange when ripe. They have eaten the fruits and they know the hard stone-like seed inside, which does not sprout easily. Ask them if the fruits are to be obtained all the year through. When do they have the fruits? Connect the season for the fruits with some pandigai as

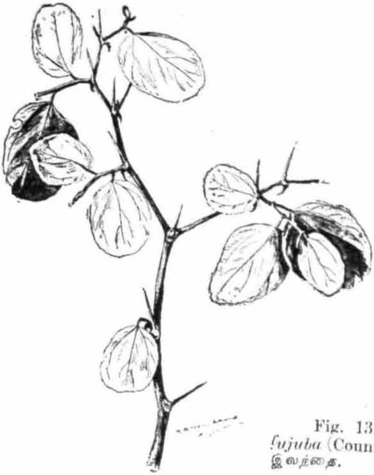

Fig. 13. *Zizyphus Jujuba* (Country Apple).
இலந்தை.

Fig. 14. *Pongamia glabra.* (Puṅgan)
புங்கன.

Pongul, and lead them to say that the fruiting season finishes before Tamil New Year's Day.

The thorny branches are sometimes used for fencing.

Pongamia glabra (Pungan).

This is a moderate-sized tree, generally met with on river banks and lake bunds.

Show the children the tree, which is easily recognised by the soft, fine, green ovate leaflets and the peculiar, flat-beaked fruits.

The branches spread in all directions. The peculiarity about this tree is that the leaves fall several times during the year. Draw their attention to the small flowers, which are white, with a slight tinge of pink.

Cut open a fruit and show them the large seed inside. Throw some dry fruits on water and let the children note how they float. Tell them how the fruits float and go a long distance, where they sprout and form independent trees. Thus the tree is distributed by water. Question them on the advantages of such a distribution.

Lead them to talk about its uses. Village people sometimes have the fruits tied round the neck or waist of children suffering from whooping cough. Tell them that useful oil is extracted from the seeds.

Pterocarpus Indicus (Vengai) may be studied if found in the locality. The fruit is a flat disc containing one seed with the centre swollen. The circular rim is papery. The seeds are dispersed by the wind, and thus the tree gets distributed.

Bassia longifolia (Iluppai).

This is generally grown in topes and on road-sides.

Show the children the tree. They may probably mistake it for the mango when in leaf only. A number of red ants are found on the tree as in the case of the mango. Compare the trunk with that of the mango : it is furrowed longitudinally and cracked across. (See Fig. 15.)

Show them the leaves, which at first sight resemble mango leaves. Procure a twig of mango leaves and let them find out the differences between the two. The mango leaf is larger and much more tapering. The mango leaves are

found all over the branches and twigs, but on this tree tufts of foliage are found at the ends of branchlets and twigs.

Fig. 15. *Bassia longifolia* (Iluppai). இலுப்பை.

The children probably notice the fine smell. Ask them where it comes from. Show them the yellow, fleshy, fragrant flowers. Let them taste the flowers and note how sweet they are. You may explain the significance of the proverb " ஆலையில்லாஊருக்கு இலுப்பைப்பூ சர்க்கரை ".

Draw attention to the green fruits and their peculiar shape, the shape of a quarter moon; some may be nearly spherical. Peel off the skin and show them the brown, big seed inside. What do they note inside the fruit? The fruit is full of very sticky juice. Tell them that it is this juice that attracts crowds of ants.

Let them talk about its uses. Useful oil is extracted from the seeds, and the oil condenses as ghee and coconut oil. The oil-cake is used to remove oil while taking oil baths. The cake is also a manure.

Balsamodendron berri (Kiluvai).

This is a sturdy little tree which never grows big. It is commonly grown as a hedge plant on account of its thorns. (See Fig. 16.)

Show the children the tree. What peculiarity do they note about it? Leaf-bearing spines are found all over the branches. Let them note the small henna-like leaves. Ask

them to squeeze the leaves and note the slight fragrance. How are the leaves to the touch? They are smooth and oily.

Fig. 16. Balsamodendron (Kiluvai).

Draw their attention to the numerous, fine pinkish flowers clustered together. They do not seem to be fragrant.

Let them observe the small pill-like green fruits which turn red when ripe. Ask them to eat some ripe fruits. What do they note? There is a slight attractive flavour about them. There is a small hard seed inside each fruit.

Tell them that the tree grows well from small branches. It forms a good hedge.

The Gold Mohur—Poinciana regia (Panjali or Saravagai).

Fig. 17. Gold Mohur—A twig and two fruits.

This is a handsome tree as regards both foliage and flowers. It looks splendid when bare of leaves and full of bloom. It grows quickly like the Thungumoonji, and is grown on road-sides; but it is not familiar everywhere.

The tree bears handsome, large, red bunches of flowers. The fruits are large, flat and sword-like being about 1½′ long and about 2″ broad. They are found hanging on the tree for several months. If the dry fruits are shaken, the seeds rattle inside.

The wood is weak and of very little value.

Albizzia lebbek (Vagai).

This is found in some places. We can see patches of bark falling away from the trunk. The flowers are small, yellow and fragrant, with numerous silky stamens of yellowish white colour.

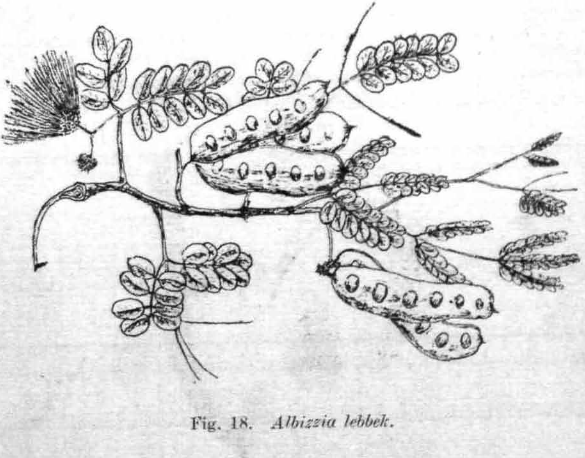

Fig. 18. *Albizzia lebbek.*

The fruits are numerous, and when ripe and dry, they are thin, papery, and straw coloured. They rustle in the breeze.

Poinciana elata (Vadanarayan).

This tree is not common everywhere. The leaves resemble those of the Gold Mohur. The flowers are yellowish white with long stamens. They change colour, becoming pale orange as they grow old. The fruit is long and narrow, and becomes brown when dry.

Albizzia amara (Usilai or Unjal).

This is common in jungles and forests. The flowers are small and yellow. The fruits are flat and thin like those of the Vagai: they turn brown when ripe and dry. The tree yields good fuel. The leaves and bark are powdered and used for washing heads, being saponaceous.

Ailanthus excelsa (Peemaram).

This is common in the Coimbatore and Malabar districts Let the children note the slightly unpleasant odour emitted by the bark. The vernacular name is derived from this fact. The tree grows to a big size.

Draw the attention of the children to the long branches. Do they note any peculiarity in the arrangement of the branches? They are in whorls (clusters) and are several in a whorl. Another interesting thing is that the boughs tend to run out horizontally and then to curve up vertically, giving the tree a candelabrum-like (கொத்துவிளக்கு) appearance.

The leaves are sparse and resemble the margosa leaves, but are somewhat larger. The tree appears more or less bare.

Flowers are small and numerous, growing on wide-branching stalks.

The fruits are peculiar. They are thin as paper, yellowish when ripe, and winged on both sides. They are easily distributed by the wind.

The leaves are used as green manure. The wood is light and may be used for "catamarans".

An allied tree, *Ailanthus Malabarica,* of the forests, yields the useful resin called "Mattippal". The resin produces a fine fragrance when burning.

Chapter 3.—SHRUBS AND WEEDS.

The Aloe (Kattalai).

Take the children out to any hedge in the neighbourhood where the common Indian aloe or Railway aloe is found. The children are able to recognise the plant.

Let them examine the leaf. What do they find at the margins of the leaf and at the tip? The leaf is prickly at the edges and there is a thorn at its tip. Now ask them why the aloe is planted to form hedges. Its thorny leaves prevent cattle and goats from entering the garden. Let them observe how the plants grow. Do they grow dense and close or scattered? They grow dense and packed, new young plants growing all round.

Let them now observe the leaf and describe it. The leaf is long, acute at the tip, white and curved at the bottom. Tear a leaf down the middle. What do they see? A tough, papery white skin is covering the leaf, and water is found inside. Did they observe the moisture before the skin was peeled off? Lead them to understand that the tough skin preserves moisture in the plant. Tell them that this is a plant which stores up water in its leaves to be used in the dry season.

Dig out a small plant carefully and show the children. The main root-like thing is swollen, and there are several side roots. Tell them the swollen part is an underground stem. Show them the shoots from this stem, and explain how shoots are given out from stems only and not from roots.

Draw their attention to a scape of flowers if available. It is very large, probably ten to twelve feet high in the Railway aloe. What do they find on the scape? A number of clusters of small greenish flowers. Give each pupil a flower and let them note the petals and stamens, which they find generally in all flowers. Some fruits are also seen. Show them, if possible, the bulbils on the scape. Tell them about the peculiarity of this plant—that young ones are found on the flower scape, which fall down and become independent plants. Also tell them that the plant is raised from the bulbils or suckers.

Now take one leaf, hold the thorny end under the big toe firmly, and place the leaf over a plank or a hard surface. Take a coconut shell and scrape out the matter from the leaf. Let the children note what is left behind. They can easily see the white, shining fibre. It is probable that children know

already that fine fibre is got from the aloe. Tell them that the fibre is strong, and that ropes and mats are made of this.

Fig. 19. American Aloe—Scape of flowers. சீமைக்கத்தாழை பூக்கதிர.

Question the children as to how their parents get the fibre. They generally take the leaves and allow them to rot for a few days in the tank or pond. They then beat them thoroughly on the plank and clean the fibre.

The Cactus or Prickly Pear (Nagatali).

Take the children out to the dry land or sandy maidan near by where prickly pear grows wild. They know that the plant is covered with long thorns.

By questioning elicit from them that the plant grows wild and thrives well even in sandy, dry places. Let them suggest

if this plant has any contrivance to store water. Water is stored in the flattened joints. Cut open one and show them the moisture inside, and the papery skin preserving it. Tell them that the parts of the plant will be thick, fleshy and full of water during the wet season, but somewhat thin and dry during the dry season, as the water stored becomes less, being used up by the plant for its growth.

Ask the children which parts of the plant these flattened joints are. They may probably take them to be leaves. Tell them these are really stem and branches. Very small leaves are seen in young plants but they fall off quickly.

If the thorns are removed, the plant forms good food for cattle, but it is very difficult to remove the thorns. Tell them there is a very rare variety of cactus without thorns, and this forms a good fodder for cattle.

Now direct their attention to the flowers. Where do they find them? Upon the little, round, thorny young fruits. What colour are they? Yellow. Let them feel the petals and find out that they are thick and mucilaginous.

Let them see the ripe red fruits. Take a fruit carefully (for they are covered with thorns too) and cut it across. What do they see inside? A mass of red pulpy matter and a number of seeds. Probably some eat the pulpy matter. Advise them not to do so, as it is unhealthy.

Tell them that it is an enduring plant and spreads very quickly. Even one joint will take root and thrive. It should not be used in hedges as it is dangerous owing to the thorns. Also it harbours snakes. The plant should be destroyed by being rooted out well and burnt.

The Datura or thorn apple (Umattai).

This is commonly met with in fields and open grounds in the village.

Take the children out to the plant and ask them if they know it. If they do not know it, give the name. Let them touch the plant lightly and smell their hands. They notice a fairly strong, disagreeable smell. Let them observe the leaf and describe it. It is large and deeply toothed unsymmetrically.

How are the leaves arranged on the stem? Are they in pairs, or opposite? They are arranged spirally. Procure twigs of other plants and trees near by and show how the

leaves are arranged alternately in some, oppositely in some, decussate in some (tumbe and madar and so on. What do

Fig. 20. *Datura.* ஊமத்தை

they learn from this? Leaves are arranged differently in different plants. (They learn the purpose of this arrangement in a different lesson.)

Let them now see the big flower which has probably been attracting their attention all through. Elicit that the flower is pure white and funnel-shaped. Is the flower open or closed? Tell the children that the flower opens at nightfall, remains open the whole night and closes in the morning some time after sunrise, and then the corolla fades away. Let them suggest other flowers which open in the evening or nightfall. They would suggest the jasmine, which opens out or blossoms late in the evening, for they see these flowers used commonly by girls at home. Ask them if they can suggest flowers which blossom in the morning. The rose, the lotus, and the flowers of vegetables like the bende, bean, brinjal, etc.

Show the children the fruits in the plant. Elicit that the fruit is a round, thorny thing. Cut open a fruit and show

them the chambers with the seeds. How many chambers and how many seeds are there? Four chambers and numerous seeds.

Question them on the uses of the plant. They might know that the leaves are used to poultice boils and abscesses. Tell them the whole plant is poisonous and should be avoided. It should be weeded out whenever found growing in the garden or field.

For the same reason, now that they have handled the plant, they should be asked to wash their hands well.

Jatropha gossypifolia (Kattamanakku).

Take the children out to a hedge of this plant. Show them the plant and give the name if they do not know it. They know about "amanakku" the castor, even if they have not seen the plant. Tell them this plant is similar to the castor, but grows wild, and hence it is called "Kattu amanakku".

Fig. 21. *Jatropha.* கெட்டு காட்டாமணக்கு.

Let them observe the plant. Does it grow to a tree? It is a shrub growing larger than what we popularly call "a plant", but does not grow to the size of a tree.

Pluck a leaf. What do they observe on the plant? Milky juice runs out. Break a twig and show them the juice coming out. What do they learn from this? The plant is full of this

juice. Tell them that the juice is unpleasant and pungent. Let them suggest if this may be of any use to the plant. The taste of the juice is disliked by cattle and goats, and hence the plant is not eaten by them. Thus the juice protects the plant.

Direct their attention to the leaves. Let them examine the leaves well by touching and feeling them. The leaves are reddish green, cleft into three or five lobes, smooth and pubescent (full of downy hair-like processes). The stem, the *leaf stalk and other parts of the plant are also full of these* hairs.

Let them look at the flowers. They are small and greenish yellow. Do they find the glandular hairs on the flowers? Yes. *Reference may be made to the two kinds of* flowers, the one with stamens only and the other with the embryo fruits only. They have known something about this under the palms and gourds (if done already).

Show them the fruits, also castor fruits from the museum. Let them note the similarity. These fruits are smooth, but the castor fruits are full of soft thorny-like processes. Cut open a fruit to show them the compartments and seeds inside. How many compartments and how many seeds are there? Three compartments with a seed in each. Direct their attention to some ripe and dry fruits which have broken open. What happens when the fruits break open? The seeds are scattered. These seeds sprout and form new plants. Tell them the plant may be propagated by planting cuttings also.

Question them on the uses of the plant. It can be safely used as a hedge-plant. The leaves are occasionally used as a poultice for wounds and ulcers.

There is another variety of the plant, *Jatropha curcas* (Vellai Kattamanakku). This may be studied as well if found in the village. This plant is a little larger than the red variety, and the leaves are larger but not so deeply lobed. The glandular hairs are absent and the leaves are green. The flowers and fruits are similar. This has also the milky juice protecting the plant from cattle and goats. Let the children examine and say what are the differences and similarities between the two varieties.

The Madar—Calotropis gigantea (Erukkan).

This plant generally grows wild in the village. Show the children the plant.

Let them pluck a leaf. What do they notice on the plant? A thick milky juice flows out. Break a twig and show them the milk flowing. Tell them the juice is somewhat poisonous and acid and hence they have to be careful about it. Can they suggest any purpose served by this juice? They would tell you that it is a protection against cattle as in the case of the jatropha.

Fig. 22. The Madar Plant.

Let them look at the stem and the leaves. What do they note? A white soft downy coating is found all over. They do not know the use of this coating. You may tell them that this is a protection against dry weather, and it helps to preserve moisture in the plant. Draw their attention to moisture being stored in the thick leaves. Ask them to look for the petiole. The petiole or stalk is very short and the leaf is clasping the stem.

Now call attention to the arrangement of leaves on the stem. Are they in pairs or alternate? The arrangement is peculiar. The leaves are in pairs and oppositely arranged,

but one pair is crosswise to the other. . They may not know *the advantage of such an arrangement.* Explain to them that the leaves desire to catch plenty of sunlight and in such an arrangement each leaf is well exposed to the sun. Generally leaves are arranged in plants in different ways, as alternate, opposite, spiral, etc., so as to allow enough sunlight to fall on the leaves. Explain this carefully.

Children often press the flower buds with their fingers as the buds open with a slight explosive noise. Let them describe the flowers. They are bell-shaped, bluish white or purplish, with five petals. There are also five peculiar, curious-*looking bodies covering the embryo fruit.* You may talk to them of the flowers being used to worship God Vinayaka.

The fruits have probably been attracting their attention, for they see the thin seeds with the silken hairy tuft being blown away by the wind. Children get the seeds and blow them up in the air for fun. Cut open a green fruit and show them the numerous seeds inside. Let them notice how they are well arranged and packed. What happens to the fruit when it becomes ripe? It turns brown, dries and splits open. What happens to the seeds? They are carried away by the wind to distant places where they grow as fresh plants.

Now explain to them the advantage of seed-dispersal. If the seeds were to fall down and grow to fresh plants near the mother plant, there would not be enough food for all of them in the limited space, and probably the family would die. Hence *plants have contrivances to send their children far away* where plenty of food is available. Recall to their minds examples of trees distributed by men and birds, like the mango, the tamarind and the banyan.

Break a fairly well-grown branch and peel off the outer skin. What do the children note? There are fibres. Peel off some fibres and let them examine them. The fibres are soft and silky and can be twisted to fine ropes.

Tell the children the plant should be weeded out if found in the garden or field, as it will interfere with the growth of regular crops.

The Mexican Poppy—Argemone Mexicana (Bramathandu).

Take the children out to a place near by where these plants are found, and give them the name. Probably they

know the plant as "Gudu-Gudu" as the seeds inside the dry fruit rattle. Draw attention to the greyish white stem and leaves. Ask them to touch the plant carefully. What do they notice? The whole plant is covered with prickles or thorns. Let them observe the leaves which are large and sharply sinuated. Can they name any other leaf toothed like this? The datura or the brinjal; but this leaf is more sharply toothed than the other two.

Fig. 23. Mexican Poppy. பிரம்மதண்டு

Cut a leaf and a twig. What do they observe? A certain yellow juice oozes out. They should not taste it; tell them the juice is bitter. Let them suggest that this is a protection against cattle and goats.

Direct their attention to the flowers. Do they grow singly or in clusters? What is the colour? How many petals? Four to six yellow petals.

Let them observe the green prickly fruits. Do they remember any other prickly fruit? The datura. Show them a datura fruit and let them compare the two. This is a little longer than the datura, and the prickles are sharper. Show them a fruit on the plant which has broken open. What

happens to the fruit when it gets ripe and dry? It breaks open and the numerous seeds inside are scattered when the wind blows. Question them on the necessity of such dispersal of seeds.

This is a bad weed and should be got rid of when found in the garden.

The Caltrops—Tribulus terrestris (Nerunji).

Take the children for a walk, and direct their attention to the nerunji or caltrops. They would have had experience of the nerunji thorns, and they will recognise the plant from these thorns. Which part of the plants are the thorny round things? They may not know. Let them observe carefully. They might then tell you that they are fruits. Ask them to carefully take a fruit each and observe well. How many compartments are there in each fruit? There are five compartments. Where are the thorns? Each compartment has two prickles or thorns. Are there thorns in any other part of the plant? No. Explain to them how the fruits are protected by thorns from cattle, and how the thorns serve the purpose of distributing the plant by sticking the fruits to men's feet. Men carry them or throw them away from the mother plant.

Direct their attention to the flowers. They are yellow and pretty. Let them smell the flowers. What do they note? The flower is somewhat sweet-smelling. Let them count the petals. Let them observe the small yellow stamens and the young or embryo fruit in the flower.

Fig. 24. Caltrops. நெருஞ்சி

Ask them to look at the leaves. Small leaflets are arranged in pairs on a stalk like a feather. Do they note any peculiarity in the colour of the leaves? There seems to be a grey colour at the margins and on the under-side. What is it due to? Let them note the small white hair-like processes on the leaf.

Let them look at the stem or the plant as a whole. It is a trailing plant growing horizontally and spreading along the ground.

Tell the children this is a weed which is commonly found growing in gardens and fields at the cost of the crops. It should be removed entirely.

The Hariali (Aruhampul).

This is a well-known plant. Probably children are not able to recognise the different kinds of grass such as hariali, nutgrass and chloris.

Let the children observe the plant creeping along the ground. Pluck a plant and show them the fairly strong, spreading roots. What peculiarity do they note about the roots? Where do they come from? Numerous fibrous roots are given off from the joints or nodes. Let them think over the purpose served by such roots. These roots gather food for the plant, and they fix firmly the long creeping stems to the soil. Explain the good binding action of these roots on the soil. It is grown on ridges and bunds owing to this quality. Also it is useful for making lawns. Show them how the underground stems go deep into the soil. As such the grass is a troublesome weed when growing with the crops.

Question them on the uses of the grass. It forms a good food for cattle and horses. Probably children are acquainted with its use in worshipping Vinayaka, the plant being called "Durvapatram" in Sanskrit.

Ask them to note the small, linear, fine green leaves or blades and the leaf-stalks forming sheaths round the stem. Direct their attention to the flower-bearing branches. Are they creeping like the stems? They are erect, smooth and about six to nine inches high, with three to five spikes or clusters. Ask them to take a flower-branch which is fairly dry and wipe it with their hands. What do they note? A number of small, hair-like, light things fly away. These are seeds. Tell them how easily the seeds spread—which is the reason why hariali grass is so common.

Tell them that if we want to grow the grass, the easiest way is to have some of the stems put in the soil and watered; then they take root and grow quickly.

The Nutgrass—Cyperus rotundus (Koraippul).

This is another grass weed common in garden and fields, which is easily recognised by the smooth, shining, dark green leaves which are larger than those of the hariali. Each flower-branchlet has 5 or 6 spikes of numerous flowers. These produce numerous light seeds which are carried away by the wind.

Fig. 25. Nutgrass. கோரைப்புல்.

Dig out a plant with the roots and show the children. What do they note? There are a number of tubers with *shoots, which would grow to fresh plants. Let the children* suggest other plants with such tubers or underground stems. They would mention the ginger if they have seen it already. Explain how the plant spreads by means of the tubers also, which are hardy and which do not die easily. Hence the tubers should not be thrown into the garden manure pit.

Let them smell the tubers and note the fragrant smell. Tell them these tubers are dried and preserved, and used to perfume bathing powders and other toilet articles. These are had in the bazaar.

Chloris barbata (Uppampul).

This is another kind of grass found everywhere, and is easily recognised by the long flower-stalk (about a foot and a half high) with a number of spikes ranging from five to twenty. The leaves are longer, being about six to eight inches in length, and larger than those of the hariali or nutgrass. The stem creeps along the ground, but the leaves stand erect; roots are sent downwards from the stem and thus the plant spreads. The flowers and fruits are similar to those of the hariali.

This is also a bad weed, and should not be allowed to remain in the garden.

Leucas linifolia (Tumbe).

This is common during the rainy season and is recognised by the lanceolate serrated leaves and the lip-shaped white flowers. Probably children know the plant, as the flowers are used for worship.

Elicit from them that the leaves are lanceolate and serrated, and are decussately arranged.

Fig. 26. *Leucas linifolia.*
தும்பை.

Let them note the typical shape of the flower. Each is short-stalked and sits in a bell-shaped calyx. The lower part of the corolla is a tube, and the upper part is divided into two lips. Are the two lips of the same size? No, the lower lip is broad, and forms the attractive part of the flower. Let each child pull out a flower and suck the tube. What do they note? There is nectar inside. Explain why insects visit flowers.

Show them how the fruits get dry and break open, allowing the seeds to be scattered by the wind.

This is also a weed to be put into the manure pit.

Note.—It is enough if the children are able to recognise the common weeds of the locality. They need not study these in detail, but they should know the chief characteristics to enable them to recognise the weeds. A few important weeds are mentioned here.

Cassia auriculata (Avarai).

This is a common shrub in wild places, but not so common in the garden. It is easily recognised by the attractive yellow flowers, and the green pods which are flat and about six inches long.

Eight to twelve leaflets are arranged in pairs on a stalk. The young branches, petioles and flower-stalks are pubescent.

The leaves and flowers are dried and powdered, and the powder is used to remove the oil when taking oil baths. The bark of the plant is largely used in tanning.

Cassia tora (Tagarai).

This is a smaller plant than "avarai" with three to five pairs of leaflets on a stalk. The flowers are bright yellow. The fruits are long, somewhat cylindrical and pointed. The seeds too are somewhat cylindrical.

This may be found in the school garden occasionally, and should be weeded out. (See Fig. 27.)

Gynandropsis pentaphylla (Velai).

This is fairly common in dry and wet lands, and is easily recognised by its flowers, leaves and fruits. (See Fig. 28.)

Let the children look at the flowers and the peculiar arrangement of the floral parts one above the other. Four

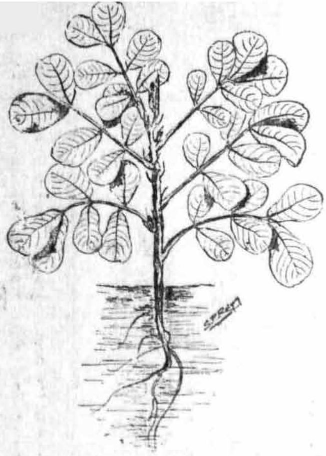

Fig. 27. *Cassia tora* தகரை.

Fig. 28.
Gynandropsis pentaphylla.
வேளை.

white petals are found spreading away from the pink stamens and brown anthers.

Let the children touch and feel the stem and the leaves. They will note that the parts are covered with glandular hairs, which are stickly to the touch. Direct their attention to the three and five foliolate leaves.

Show them the long round furits with the numerous little seeds.

Let them crush a leaf or fruit, and smell. They note a peculiar asafoetida-like smell. Tell them that the plant may be easily recognised by this characteristic smell.

This is a weed to be cast out of the garden.

A similar weed is *Cleome viscosa* (Naai Velai).

Tridax procumbens (Naai Javanthi).

This is very commonly met with everywhere, and is recognised by the small yellow flower-heads like tiny

Fig. 29. *Tridax.* நாய் ஜவந்தி or பிள்ளையார் ஜவந்தி.

chrysanthemums. When the plant is not in flower it is recognised by the ovate leaf, which is well toothed at the two sides or margins.

Let the children feel the stem and the leaves, and note the bristle-like processes on them.

The flower-stalks stand erect and are a foot high. The small seeds are easily carried away by the wind.

Trianthema decandra (Saranai).

This is easily recognised by the thick, fleshy, round or

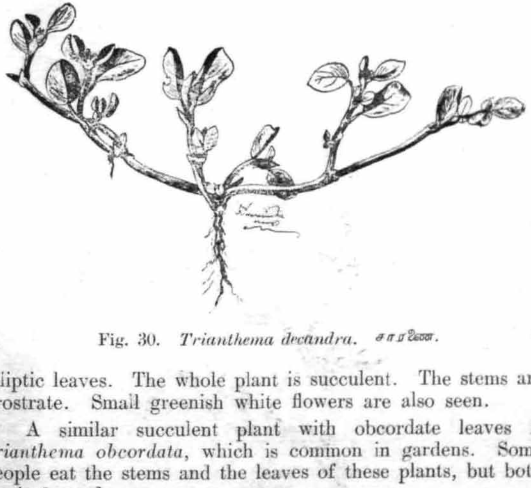

Fig. 30. *Trianthema decandra.* சாரணை.

elliptic leaves. The whole plant is succulent. The stems are prostrate. Small greenish white flowers are also seen.

A similar succulent plant with obcordate leaves is *Trianthema obcordata*, which is common in gardens. Some people eat the stems and the leaves of these plants, but both are bad weeds.

Euphorbia hirta and thymifolia (Amman pacharisi).

This is a fairly common weed, with the branches creeping along the ground. The leaves are ovate, serrate, slightly pinkish and oppositely arranged. Small pinkish flowers are found crowded on short peduncles. The small fruits get dry and break open, scattering the tiny seeds. (See Fig. 31.)

Phyllanthus niruri (Keelanelli).

This is a small plant growing to a height of about 2 feet, and is easily recognised by the tiny elliptical leaves

Fig. 31. *Euphorbia hirta.*
அம்மான் பச்சரிசி.

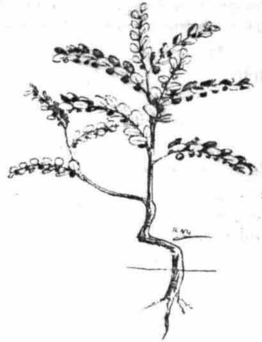

Fig. 32. *Phyllanthus niruri*
கீழா நெல்லி.

arranged like a feather in pairs on a stalk. Underneath the leaf-stalk are seen numerous round little flower buds. The branches grow elect. (See Fig. 32.)

The juice of the plant is mixed with oil for bathing, and is considered to have a cooling effect.

Fig. 33. *Acalypha indica.* குப்பமேனி.

Acalypha Indica (Kuppameni).

This weed is also common in gardens, and is recognised by the ovate or heart-shaped, serrated leaves. The plant grows to a height of about two feet. Small greenish flowers are sometimes seen. (See Fig 33.)

The juice of the leaves is sometimes applied in cases of itch.

Achyranthes aspera (Naayurivi).

This weed is easily recognised by the long peduncle or flower-stalk, which is prickly. The plant sometimes grows to a height of about four feet. The branches are somewhat four-sided, and leaves are more or less round, and are on short petioles.

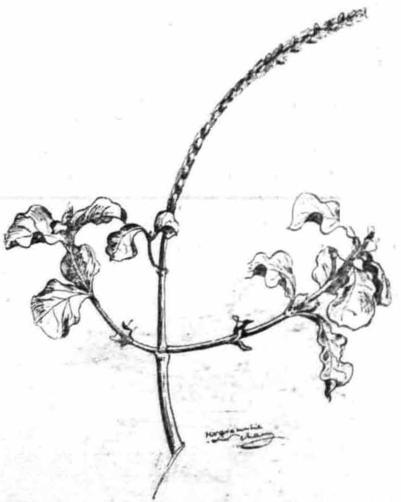

Fig. 34. *Acyranthes aspera.* நாயுருவி.

Let the children look at the flowers, which are horizontal at first, but afterwards become reflexed downwards. The bracts on the flowers are at first soft, but soon become rigid and prickle-like. If we pass our hand over the flower-stalk

from the bottom to the top, our hands would get hurt. The flowers are small and purplish, and are inserted on the stalk in numbers.

Boerhavia diffusa (Mookarettai).

This is common everywhere. It is a low creeping plant, with many diffused stems or branches. The leaves are ovate,

Fig. 35. *Boerhavia.* மூக்கரட்டை.

rather roundish, bright green above and whitish below. The flowers are pale rose-coloured, and are scattered on long branching peduncles from the axils and the ends of branches. Rough, small striated brown seeds are found. This is a deep-rooted plant and lives long. It is a bad weed, and should be thoroughly rooted out.

Chapter 4.—COMMON VEGETABLES.

The Plantain.

The children need no introduction to the plantain: they are quite familiar with its leaves, flowers and fruits.

What is the colour of the unripe fruit? What is the colour of the ripe fruit? Let the children handle the fruit, and get them to say that it is long and

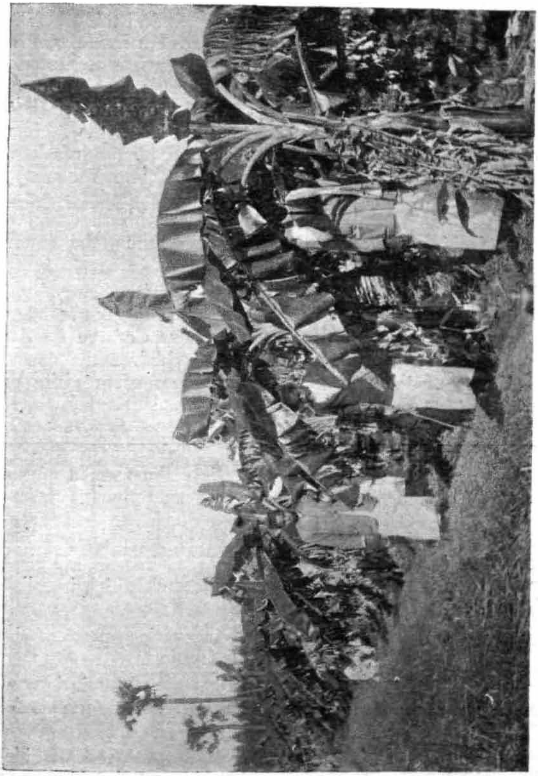

Fig. 36. Plantain.

big, tapering at both ends. Show different kinds of plantain, such as puvan, mondan, rasthali, pachai nadan and so on, and let the children name them and discuss the differences in *shape, size and colour.*

Show them the entire flower, the big conical thing. Is it one flower? Show them the numerous flowers inside. How *are they arranged?* Let them observe the flowers in clusters, each cluster being covered with the leathery spathe. Do all the flowers grow into fruits? Do they all grow into fruits at the same time? What becomes of the spathe as the flowers mature into fruits? Only about a dozen or more of these clusters of flowers nearest the base mature into fruits, the spathes falling off as the flowers mature and fruits appear. The rest of the clusters fall off gradually with the spathes without fruiting. That is why, after some time, the flower spike is cut off and used for cooking.

Take one single flower, and show the children the embryo fruit, stamens, and the styles. The styles of the flowers near the base are prominent, whereas the stamens of the flowers near the end are prominent. Show the children the nectar at the base of the flowers. Why do bees often visit the plantain flowers? How many spikes will a plant put forth?

Let them observe the large leaves with the strong midribs and the long sheath clasping the stem. Take off the sheaths from a plant and show that the stem is really formed of the sheaths of leaves. Tell them that the stem proper is under-*ground and is the tuberous mass from which shoots are sent* up. What is there inside the apparent stem above? In young plants shoots of leaves are found, and in a mature plant you have the long, white flower or fruit stalk which is called "thandu".

Talk to them about the uses of the various parts of the plant. Why is the plant cut off after fruiting?

Also draw attention to the fact that the plaintain is used to decorate pandals and houses on festive and ceremonial occasions.

Cut open a fruit and show the numerous seeds inside. Explain that these seeds do not develop and that the plant does not grow from the seeds. Take the children to see a *young plantain, and let them observe that, if they wish to grow* a plantain tree, they must plant a shoot with the tuber. Let them also observe how plants are given out from the under-ground stems of full-grown trees.

The plantain fruit makes a useful exercise in clay-modelling and drawing, but care should be taken that the essential characteristics of its appearance are brought out in the clay model or drawing.

The Brinjal.

Children would easily recognise the plant in fruit, for they know it well. But they should be able to recognise the various parts of the plant even when it is not in fruit.

Get different varieties of brinjal fruits either from the school garden or from the bazaar and show them to the children. Ask them to describe the colour and shape of the fruits. They are smooth and oval or a little spherical. The children will notice how strongly the stalk and calyx are attached. They are of various colours from deep violet to rose. Some are also light green, and some are streaked; e.g., violet streaks appear on white fruits and white streaks on violet fruits, and so on. Cut open a fruit and show them the numerous small seeds in it.

The young fruits are cooked and eaten. A few fruits are allowed to mature and become ripe yellow for seeds. The seeds are gathered and dried. These are sown to get fresh plants. Place some of these seeds in the museum.

The flowers are easily recognised from the purple or rosy coloured corolla and the green calyx. Let the children observe the solitary or single flowers. They are not found in clusters or bunches. Each flower grows to a fruit. Let them note the peculiar reflexed position of the flowers. They are all bent down. Why is this? Then only can the heavy fruit grow down; the fruit cannot grow up, being heavy. The reason why the flowers point to the ground is that the fruit, being heavy, must grow downwards; as the fruit comes from the flower, therefore the flower must grow downwards.

The leaves are ovate in shape. The edges are wavy, with distant inward and outward bends. The leaves are generally downy to the touch.

The brinjal is a shrub and does not grow very high. Show the children how the stem is clothed with star-like hairy growths.

Ask the children if they can get brinjals all the year through. Brinjals flower and fruit all the year through but the fruits are to be had abundantly in the rainy months,

when the plant grows well and gives forth numerous fruits. Tell them the plant grows for some years, but the fruits get dwarfed in the second and succeeding years, and hence the plants are generally destroyed after one fruiting, and fresh plants are grown.

The brinjal may be used for clay-modelling and drawing. Place the best specimen in the museum.

The Chilli.

Children can easily recognise the chilli when in fruit, especially when the plant is bearing the ripe fine-looking scarlet fruits. Both green and dried chillies are used daily in cooking, pickling, etc., owing to their pungent nature.

The fruits are generally long, but the round variety is also common. Show them the fruits in the garden and let the children observe them. Ask them how they grow, singly or in clusters. They grow singly. Generally they hang down: only rarely do they grow erect. What other fruit is similarly pendulous? The brinjal. Let them look at the calyx attached to the fruit and the strong stalk. Had the brinjal the calyx attached? Cut open a fruit and show how the seeds are arranged in two compartments. Ripe scarlet fruits are taken and dried and the seeds sown to grow fresh plants. Let them compare these seeds with those of the brinjal. Though the chilli plant can stand for a few years, it is generally rooted up after one season as the fruits become very inferior after the first year. Are green chillies to be had all through the year? Yes, but the fruits are gathered and dried in January and February. The plants are then destroyed.

Let the children observe the flower. How does it grow? It grows downwards. How many petals are there? The appearance of the small white flowers with the green calyx growing singly will be easily remembered by the children.

The leaves are small and entire. Compare the size and shape of the leaves with the leaves of the brinjal. The chilli is a very leafy plant.

The chilli is a small plant. Compare its height with that of the brinjal.

The Bende.

Children are acquainted with the unripe fruits as it is used as a vegetable.

The fruit is easily recognised by its elongated shape and ribbed surface. Squeeze a fruit. What do the children note? It is slimy. They will have noted this in curries made of this vegetable. Cut a fruit across and show the children. What do they see? Numerous seeds are found in the 5 to 8 partitions. The fruit-stalk is short, thick and somewhat reddish in colour. Show them a ripe and dry fruit left on the plant for seeds. What do they notice? The fruit gets very dry in the plant and splits open, scattering the seeds. Probably they have already realised the necessity for such dispersal of seeds. If the seeds fell straight to the ground, the young plants would all spring up close to one another, and would not grow properly for want of sufficient food.

Show the children the flower. Is it big or small? What is the colour? Do the flowers grow singly or in clusters? Do all the flowers grow into fruits? Yes. Let the children answer these questions. Have they seen similar flowers? They might suggest the cotton flower if they know it already, or the portia, which they are familiar with. Tell them the portia and the cotton belong to the same family and hence their flowers are all similar. Show them the small infant fruit in the flower.

Let them feel the leaves. They are large and covered with minute bristles. Even the stem and the leaf-stalks have these bristles. Let them find out if all the leaves are similar. Some leaves are large and not lobed; others are smaller and lobed.

The plant grows fairly high. It is cultivated by sowing the seeds. The ripe dry fruit is taken from the plant just before it splits open. The seeds are gathered, dried well and sown. The plant is allowed to stand for one season only.

Let the children place a few fruits and seeds in the school museum.

Lab-lab.

The Bean.

Procure flowers of "agathi" and "mullu-murungai" (Erythrina Indica), if available.

All children know this plant as it is grown in most houses. Children can recognise the fruit, flower and leaf individually as they have seen them so often.

Take the children to the garden and show them the plant. What striking difference do they note between this and other plants? The plant does not grow erect. It is a twiner or a climber. Why does it climb up like that? Look at the stem and the foliage. The stem is so thin and weak that it cannot stand erect with its load of leaves, flowers and fruits. So we *have to put up a "pandal" for the plant to climb up and* spread in all directions. Let the children think over and tell you what would happen if no support were given and no "pandal" put up for the plant to spread itself over. The plant would try to creep along the ground, its parts would grow close together and there would not be sufficient sunlight falling on the leaves. Thus the plant would be stunted and the yield would be poor.

Let the children observe and describe how the stem and branches climb up and spread. In the beginning the stems or branches grow straight up; then their tips bend and begin to make a circular movement and seek a support. When the tips find a support, they turn round this and grow high. As the plant grows bigger the tips of stems or branches continue their circular movements and wind themselves round the support.

Show the children the fruits. Break open a few and let them see how the seeds are arranged inside. Put them questions on the kinds of fruits, their colour, shape, etc. What happens to the fruits after they get ripe and dry? In some cases they break open into two halves, scattering the seeds.

. *Question the children on the flowers.* What do they look like? How many petals are there? Are all the petals equal? What is the colour of the flowers? Different kinds are differently coloured. Are the flowers in clusters? Does each flower produce a fruit? What do they see visiting the flowers? Is there the small embryo fruit inside the flower?

Show them the "agathi" or "mullu-murungai" flowers. Are they similar to those of the bean? Do they belong to the same family then? Can they suggest other plants of the same family? They may not answer this question. Tell them "mochai", grams and cluster-beans all belong to this family. Their flowers are all alike. But the stems of all are not *twiners and climbers.* Show them the cluster-bean in the garden. It grows erect, the leaves are somewhat different, but the tiny white flowers are similar to those of the bean. Show them the flowers and fruits in clusters.

Let the children observe the trifoliate leaves with the long petiole. Are all the three leaflets similar? What do they observe? Let them compare these leaves with those of the cluster-bean.

The plant is generally allowed to stand for one year, though it occasionally stands for two years. The plant is propagated by sowing seeds. Do we get beans in the bazaar all through the year? They are had in plenty only in December and January.

The Onion.

Probably the children cannot recognise the plant, but they are all familiar with the bulbs which are used as a condiment in cookery. Take the children to the garden and show them the plants. Ask them what these plants are. They may not know. Pull out a plant and show them the bulbs underground, and now they can recognise the red bulbs and readily tell you what the plant is.

Show them the leaves and question them on their shape and appearance. They are long, green and grass-like. What are the bulbs? Probably they think they are roots. Show them the small roots from the bulb growing underground. Tell them the bulbs are not roots though they are underground, but a modified form of the stem. Cut through the leaves and the bulb vertically and show them the arrangement of the scales in the bulb. What is the bulb made of? Scales or stalks of leaves which are thick and fleshy. Show them the leaf and flower buds within the scaly leaves. Tell them how food is stored in the scales for future growth, and how the plant is propagated by planting one bulb which takes root and gives forth new bulbs.

Show them the tiny white flowers and the little green fruits. There are small seeds. The plant may be cultivated by sowing seeds also. Gather some of the seeds for the museum.

Tell the children that the plant dries off after one year; the bulbs are gathered and used, a few being reserved for planting again.

The leaves are also used by poor people as a vegetable.

Tell them that garlic is a similar plant. Show them some garlic bulbs.

The Radish.

Take the children to the garden and show them the radish. Ask them if they know what it is: probably they do not know. *Pull out a plant and show them the root, and they immediately* recognise the radish as it is the root that is used as a vegetable.

Show them the root and let them describe it. The root is big and swollen. There are small side roots from this main root. Now pull out a plant which has been allowed to stand over a season for flowers and seeds. Show the root. What differences do they note between this main root and the one they saw before? This is reduced in size and is woody. What has happened? Suggest to them that food was being stored by the plant in the root to be used later on, and that has been used up now, and hence the root is so thin. This plant has flowers and fruits.

Let the children note the yellowish flowers and the small fruits. Show them the tiny seeds inside the fruits. Explain to them how radish plants are gathered after a few months for the roots, leaving a few to flower and give seeds for further cultivation. Radish plants are propagated only from seeds.

Let the children observe the big lobed or sinuated leaves. Ask them if the leaves are used for anything. Generally cattle eat them.

Tell the children that the English vegetables such as the cabbage, cauliflower and knolkohl are similar plants, but the leaves of the cabbage, the flower bud of the cauliflower, and the root of the knolkohl are used as vegetables. Mention this only if these vegetables are grown in the school garden.

The Snake-gourd.

This is a common vegetable, and the children probably know the plant and the fruit. Show them the plant spread on the pandal. Recapitulate the lesson on the lab-lab, and elicit that the stem is weak and thin, and is unable to bear the weight of the leaves and fruits unless it has the support of a pandal. What differences do they note between this plant and the lab-lab? Let the children examine the stem, leaves and flowers. Elicit from them that the stem of the snake-gourd is succulent, angular, hairy, and generally weaker than the lab-lab stem. The leaves are single and hairy. They are cordate, sinuated and denate. The flowers are small and

white, with five petals which are all equal and thus different from the lab-lab flowers.

Are all the flowers alike? Do all the flowers produce fruits? No. They know there are numerous flowers: many are in clusters and a few are seen singly. All flowers do not produce fruits; only a few do so. Can they recognise which flowers produce fruits? They can identify the small embryo fruits under the few flowers, forming apparent stalks of these flowers, and these are the fruiting flowers. In the other flowers these embryo fruits are absent and the flowers are therefore non-fruiting. Explain to them the differences between the two kinds of flowers. The one is the staminate flower with the stamens and pollen, and the other is the pistillate flower with the embryo fruit. What did they note in the bende, brinjal and the lab-lab? Were there two distinct kinds like this? No. The stamens with the pollen, and the pistil with the embryo fruit were in one and the same flower. Did each flower produce a fruit? Yes, unless the flower faded and fell down. Ask them if they remember having seen two such different kinds of flowers in any tree they have studied. The coconut palm and the palmyra palm. Did they note any difference between the coconut and the palmyra even in these two kinds of flowers? The coconut has these two kinds of flowers in the same tree, but in the palmyra two different trees produced the two kinds, one tree producing staminate flowers only and another tree pistillate flowers only.

Tell the children that the pollen from the staminate flower should fall on the pistil of the other flower for the embryo fruit to mature. Show them the insects moving about the flowers and explain how pollination is caused.

The long cylindrical snake-like fruit is well known to them. Show them the seeds inside. How is the plant cultivated? By sowing seeds. One or two fruits are allowed to ripen, the plant becoming red when ripe. Then the seeds are taken, dried and preserved for sowing. Do we have fruits all through the year? Yes, but there is a season when they are had in plenty—October to December.

How does the plant climb up the pandal? How did the lab-lab climb up? Show them the tendrils which hold firmly to the supports. Let them observe the spiral twisting of the tendrils. Where are the tendrils found? How many tendrils are there? Let the children observe these aids in nature for climbing.

The Cucumber and other gourds.

Deal with the cucumber and other gourds as with the snake-gourd. *Show the children the tendrils for climbing* and spreading. The chief point to be noticed in all is the two kinds of flowers.

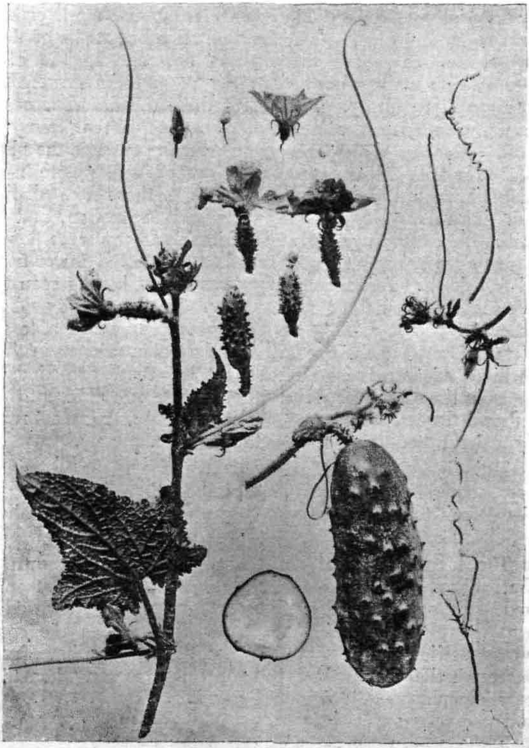

Fig. 37. Cucumber.

The cucumber, the bottle-gourd, the pumpkin and melons are not provided with pandals, but are allowed to spread along

the surface as their fruits are very heavy. But the bottle-gourd and the ribbed gourd are allowed to spread over roofs of houses though it is not advisable to allow them to do so, for they damage the roofs. The bitter-gourd is generally provided with a pandal, also the ribbed-gourd. Show the children all these.

Show them the leaves, which are all similar. with hairy or bristly processes. The leaves of the pumpkin, ribbed-gourd and bottle-gourd are larger than those of the cucumber and bitter-gourd. The flowers are all similar, and are yellow excepting those of the bottle-gourd, which are white.

Let the children note well the similarity and dissimilarity between these gourds. The fruits of these are all easily recognised by the children. Show them the numerous seeds within the fruits. Let them learn when fruits for seeds are to be taken from the plants, and how the seeds are to be preserved. Tell them also how these are usually sown in Adi or August before the rains.

The Ginger.

Take the children to the garden and show them the plant. They may not know the plant. Pull out a small portion and show them the part underground. They recognise the ginger. Probably some mistake this for turmeric. Let the children taste the tuber and they immediately recognise the ginger.

Let them examine the root-tuber or ginger. What do they notice? Small buds. Show them how these tubers creep or spread along underground, giving forth new buds. These tubers are aromatic and are used as spices and in medicine. Specially dried ginger is largely used medicinally. Tell them how the plant is propagated by the tubers and not by seeds. Examine the root, and explain that it is not really a root, for roots do not give forth buds and branches. These tubers are underground stems. Show them the small roots from the tubers. Similarly turmeric and arrowroot are underground stems, and they are cultivated by planting bits of underground stems. Tell them these plants are rarely allowed to flower. So they are not propagated from seeds.

Let the children examine the leaves. They are large and oblong, with sheaths attached to the stems. Take a leaf and show them. Let them bruise a leaf and note the ginger smell. In the case of the turmeric leaf, which is similar,

they note the turmeric smell. The ginger is allowed to stand for one full year before the tubers are gathered.

Similarly deal with the turmeric which resembles ginger very closely. Let them give the uses of turmeric.

Can they suggest other plants which have similar underground stems? The nutgrass (if they have done it already) and canna found in the garden. Let the children compare these with the ginger.

The Drumstick.

Show the children the tree in the garden. They can recognise the tree, for they use the leaves and the fruits as vegetables.

Ask them to observe the tree. Does it grow big? Is it strong? What is the colour of the bark? What peculiarity do they note on the stem? By thus questioning, elicit from them that the tree is small and slender, rarely growing very large. The stem is often knobby with a greenish grey bark. On the stem is found gum here and there which is not very sticky. You may tell them that the bark is used medicinally for swellings and sprains.

Let them now observe the leaves. They have a graceful appearance like ferns. Small numerous leaflets are found on a stalk and two or three such stalks in a common petiole arranged like a feather.

Show them the flowers. They grow in clusters. They are small and white with green calyx, white petals and yellow stamens.

The fruits are long, slender and ridged. They know the pulpy matter inside, for which the fruits are cooked and eaten. Split open a fruit and show them the seeds. What peculiarity do they note in the seeds? They are triangular and winged. Are the wings of any use? The fruits ripen and get dry. Then they split open and scatter the seeds. The seeds get dispersed. Is there any advantage in getting the seeds thus dispersed? They should know the answer.

The tree is grown by sowing seeds. The tree is quick-growing and yields fruit in one year. Branches when planted also thrive.

The Amarantus.

There are several varieties of this plant or vegetable, but two only are very common. One grows high with thick succulent stem and the other grows short and

spreading அரைக்கீரை. The latter is considered to be very wholesome, especially for convalescents.

. The children may readily recognise both the varieties, as they are grown commonly in backyards of houses. Show them the larger variety in the school garden. Elicit from them the following. The stem is thick, succulent, herbaceous and erect; the leaves are broad, lanceolate with long petioles. What parts of the plants are eaten? Both the leaves and the stem are cooked and eaten. Often the young plants are considered more tasteful. Seeds are sown close and the plants grow dense. The plot of ground on which they grow is thinned by taking off plants now and then to allow room for the remaining plants to grow well. Only a few plants are allowed to stand for seeds.

Show them the flower panicles. Where are they? They are terminal. Let them look at the numerous small flowers. Explain how the seeds are gathered. When the seeds are mature the flowers are gathered and dried, and the seeds are squeezed out and preserved. The plant is propagated from seeds.

The shorter variety is similar to this in all respects except that it grows short with spreading branches. The branches are cut off and used. The plant puts forth new shoots and grows. The flowers are similar. Seeds are gathered similarly and sown.

The plants can be grown all through the year but they require a good supply of water.

The Coriander.

Children can easily recognise the plant from the small, digitate, deeply and closely serrated fern-like leaves. Let them touch the leaves and note the fine aromatic smell given off. They cannot forget the characteristic smell. The leaves are used daily in cooking as a condiment or spice.

Ask them if other parts of the plant are used. The seeds are used largely in cooking. Show them the seeds. They are round and hard and easily break into two halves. Let them note the smell in the fruits also.

Explain to them how they are grown in the backyards for the sake of the leaves, and in dry lands on a large scale for the fruits or seeds.

Show them the tiny white flowers. In our gardens and backyards we do not allow the plants to flower, but we use the leaves. When cultivated in large numbers in the fields they are allowed to flower.

The seeds have a hard covering and hence they take six or seven days to germinate.

The Agathi.

This a quickly-growing plant, elegant in appearance, and you have probably some plants in the school garden. The children know this plant, as the leaves are sometimes cooked and eaten. They are also largely used as fodder for cows.

Show them the small oval leaflets found in numbers on a petiole. Let them suggest plants having similar leaves.

They have seen the flowers already in connection with the study of the lab-lab. The flowers are large and white. They are butterfly-shaped. Let them suggest plants having similar flowers.

Show them the long thin fruits hanging from the plant. They get ripe and dry and break open, scattering the seeds. Show them the seeds inside the fruit. They are like lab-lab seeds but somewhat smaller.

The plant is cultivated by sowing seeds. Where are the plants generally grown on a large scale? They are commonly *cultivated with the betel-vine. Take the children on an ex-*cursion, and show them how betel-vines are allowed to climb over the stems of agathi.

The Sembu (Colocasia).

Children probably know the plant, as some people use the leaves and the leaf-stalks as vegetables, besides the tuber roots which are used as a regular vegetable. Where are these plants commonly grown? Tell the children that the plant requires much water and hence grows well in shady and moist places. Take them and show a variety of this plant which grows on the sides of channels and rivers. They will know that this variety is not eaten.

Show the children the plant. Can they recognise it? Root out a portion of the plant and show them. They recognise it as the "Sembu". Show them the root tubers and let them examine them. What do they notice? Small buds

at the ends. Let them compare these with the ginger. Are these roots? They are stems, for they throw out shoots, and roots cannot do this. Show them how these shoots are thin at first and then get swollen. Explain how they become filled with starch. The tubers are cooked and eaten. They can be preserved for a long time. The plant is propagated from the tubers.

Let them observe the leaves. They are large and glabrous, ovate and divided at the base. Do they note any peculiarity in the attachment of the leaf to the stalk? The stalk is not attached at the base of the leaf but more or less in the middle. Let them observe the veins radiating from the end of the stalk. Let them feel the leaf. It is wax-like. Throw some water on the leaf. Does it adhere to it? No: it runs off in silvery drops. Can they suggest any similar leaf? They may suggest the lotus or the water lily. Do cattle eat the leaves? No. Why not? The plant as a whole has an acid taste, and hence cattle avoid it. But when we cook and boil the roots, the acid taste partly disappears. Sometimes the acid taste remains after cooking, and the children know how they suffer from eating such a curry.

Do they see flowers in the plant? No. Tell them flowers are rarely seen in the cultivated kinds but are fairly common in the wild varieties in channels, tanks and rivers. You can procure some flowers, if available, from such plants and show them. Let them observe the spathe and spike of flowers. The fruits ripen rarely.

Treat similarly if the yam on Elephant yam (Alocasia) is cultivated in the garden or in the neighbourhood. The leaves are somewhat different, being deeply lobed. This is cultivated by planting the tubers.

The Sweet Potato.

The children know the swollen roots, as they are cooked and eaten. Show them the plant in the garden: they may not recognise it. Pull out a part of the stem with the tubers and they will recognise the plant.

Show them the tubers and let them examine them. Do they find any buds or eyes in them as in the potato or ginger? No. Let them say which part of the plant these tubers are. They are roots which get swollen by the food matter stored in them: they are not stems as in the case of the ginger and potato. Which other plant had such swollen roots? The

radish. But are these tubers similar to the roots of the radish? No, they are somewhat different; these are side roots, but in the case of the radish it was the main root that was swollen.

How does the plant grow? It creeps along the ground. Let them observe the stem and leaves. The leaves are fairly big and are digitately lobed. The stem and the leaves have a reddish tinge about them.

The plant should be allowed to stand for two seasons before flowers appear. But the tubers are generally removed before the plant flowers. If flowers are found show them to the children. Let them note the bell-shaped flowers. The flowers do not grow generally into fruits. But how then is the plant propagated? By planting stem-cuttings. Explain to them how the cuttings are preserved after the tubers are removed for replanting.

There are two kinds of sweet potato, one giving red and the other white tubers. Which do they prefer? Which is more tasteful?

The Tomato.

This is not very common in villages, but it is very easily cultivated. Children probably know the fruits, which are to be had in the bazaar. If you have it in the school garden show them the plant and the fruits.

The fruits are big and round with the calyx attached to them. Does the fruit suggest any vegetable they have already studied? The brinjal. Tell them this belongs to the brinjal family. The unripe fruits are greenish white, and the ripe ones are beautiful red. Cut open a fruit and show them the numerous seeds inside. Are the seeds similar to those of other plants they have seen? Refer them to the seeds of the brinjal and chilli.

Show them the flowers. Let the children note the similarity of the flowers to those of the brinjal and the chilli, with the green calyx.

Show them the leaves. There is a long stalk, and the small serrated or toothed leaves are arranged irregularly on the stalk. The whole thing is one leaf.

The propagation of the plant is similar to that of the brinjal and the chilli. Ripe fruits are taken and the seeds are gathered, dried and preserved for sowing. The plant can

be grown all through the year. It grows well and gives fruits for one season only.

The Potato.

This is a very common vegetable. Let the children say where we get potatoes from. The plant grows well in cool and moist places, specially in elevated places. But you can try it in the school garden, growing it in a shady and moist place. A lesson on the potato may be taken if the plant is grown in the garden.

Tell the children how the plant is grown by planting the "eyes" or buds of the potato. Which other plants are cultivated like this? The ginger, turmeric and colocasia. What is the potato then? It is the underground stem in which food matter (starch) is stored by the plant for future use.

The stem does not grow high, and the leaves are large, small leaflets being arranged feather-like on the common long petiole.

Tell the children how the plant is not allowed generally to flower, but the tubers are gathered before flowering. Elicit from them that there is no necessity for flowers and seeds as the plant is cultivated from the tubers. You may tell them that the flowers are similar to those of the brinjal and chilli. The potato belongs to the same family. If the plant is allowed to flower and grow for a long time, the tubers would get shrivelled, the stored food in them being used by the plant. Hence the tubers are gathered before the flowers come. Let them compare this with the radish.

CHAPTER 5.—FAMILIAR FLOWERS.

The Rose.

Children know well this queen of flowers. They are well acquainted with the flower, its beautiful colour and the sweet scent. They also recognise the plant and love to have it in their houses.

Take the children to the garden and show them the rose-plant in flower. They would recognise the plant even when not in flower. Ask them how they recognise the plant. From the prickles and the leaves.

Fig. 38. Rose. ரோஜா.

Let them examine the stem and the branches. What do *they observe? They will at once point to the prickles or* thorns. They are sharp and bent slightly downwards. Tell them that the stem and the branches of the cultivated rose are pruned and are not allowed to grow long, but the stem and the branches of the plant in the wild state grow long, and they support themselves on hedges, walls and other supports with the help of these prickles. Ask them if the prickles are of any other use to the plant. They protect the plant from cattle which would eat it and from snails which would crawl up to the leaves and eat them. Let them mention other plants with prickles or thorns to protect themselves. They would mention the babool and the korakapuli if studied already.

Let them now observe the leaves. Elicit from them that the leaves are 5 and 7 foliate, consisting of a middle rib or stalk with 5 or 7 serrate leaflets arranged like a feather, the odd leaf being at the end of the stalk or midrib. Direct their attention to the base of the stalk. What peculiarity do they note? At the base they see two stipules or leafy growths. Ask them what is the use of these growths. What do they find at the axils of the leaves? Young buds. The stipules protect these buds until they develop and open out.

Now direct their attention to the beautiful flowers and buds. The stalk is hairy, the bud is covered by the green calyx consisting of five leafy growths. Let them describe the flower. The flower has the calyx attached to it. There are numerous petals and stamens. Where is the embryo fruit in the flower? Show them the fruit underneath the calyx. Cut open one and show them the small seeds inside. Tell them the rose is not cultivated from seeds but from cuttings and by layering, for the seeds do not usually get ripe for sowing.

Probably they have not seen different kinds of roses with the various shades of colour such as deep red, crimson, white, yellowish and so on. Tell them about these and how they are got by grafting, about which they would study in the higher classes.

Ask them if they know of rose-water. When do we use rose-water? Tell the children that the rose is cultivated on a large scale in some places in order to prepare attar and rose-water.

The Jasmine.

Children are well acquainted with the beautiful, sweet-smelling flowers. The flowers are worn commonly by ladies and are used on marriage and festive occasions. Elicit these facts.

Fig. 39. Jasmine. மல்லிகை.

Show the plant in the garden. Ask them about the general appearance of the plant. Does it grow erect? Does it grow to a tree? The plant is a twining shrub and gows bushy, hanging all round if proper supports are not found for turning round. In the school garden there is probably a small pandal put up for the plant to spread over.

How are the leaves arranged on the stem and branches? The leaves are ovate and oblong, pointed, smooth and of a shining deep green colour. They are oppositely arranged. The children can identify the plant from the leaves even when the plant is not in flower.

Show them the flowers. Do they note any difference between the smell of this and that of the rose? The jasmine smell is very strong but that of the rose is mild. When is the jasmine smell strong, in the morning or evening? The smell is particularly strong in the evening. When do the buds open and flower? The buds open in the evening when the smell is also strong. Let them examine the calyx and the several segments in the flower. Tell them that generally white flowers open in the evening and have a good scent. The insects which visit the flowers at night are attracted by the white colour and the sweet scent.

Tell the children that the flowers do not grow into fruits; therefore seeds are not used for propagating the jasmine. The plant is propagated by layering and from cuttings.

They know there are different varieties as mulla, double jasmine, koddamalle and so on. But all are similar in growth and habits.

Ask them if jasmine flowers are had all through the year. They are had in plenty during the marriage season, i.e. from March to May. Jasmine flowers are not usually had from August to February.

The Oleander (Nerium Odorum).

You have probably a few shrubs of arali in the garden, and the children know the flowers and the plant. The flowers are used for worshipping, being worn on the head, and for making garlands when jasmine flowers are not obtainable.

Show the children the shrub in the garden, and elicit

Fig. 40. Oleander. அரளி or அலரி.

from them that the plant is a shrub and does not grow large to a tree. They can recognise the plant from the characteristic leaves. The leaves are linear lanceolate, thick and with marked veins underneath. Let them observe the leaves on a twig and say how they are arranged. They are three in a whorl.

Show them the flowers. There are two or three kinds, such as deep red, rose, and white flowers. If no specimens are found in the garden, ask them about the different varieties, which they will have seen. There is the five-cleft calyx and inside the corolla are torn and unequal segments. Tell them *that the flowers are had in plenty from June to September.* Refer to the lesson on the jasmine, and elicit that jasmine cannot be obtained in these months.

The plant is *not propagated from seeds but from cuttings* and by layering.

Impress upon their minds that the flower and every part of the plant is deadly poisonous. So they should take particular care to see that they do not eat any part of the plant.

Vinca Rosea.

This is a small shrub that flowers in gardens throughout the year. Show the children the plant in the garden. They

can recognise it from the red and white flowers and the elliptic leaves coated with down.

Fig. 41. Vinca Rosea. சிலுக்க மல்லி or நித்திய கல்யாணி.

Let them examine the leaves now. Elicit from them that the leaves are elliptic and are oppositely arranged. Though they appear smooth and shining there is a downy coat on them. Do the leaves suggest any other plant? The madar leaves. What purpose does this coat serve? What purpose did it serve in the madar plant? It prevents the evaporation of water from the leaves, and thus stores up moisture to be used by the plant in dry weather. Lead them to understand that because of this storing up of moisture, this plant does not fade so much as other plants do in time of drought.

Show them now the flowers. They are red and white. They grow in paris on the axils of leaves. Let them observe the five segments in the calyx and the corolla and the long tube forming the flower. Cut open a flower and show them the five short stamens, and the two seed vessels at the bottom of the tube.

The flower is not much used. Let them smell the flowers. There is a slight disagreeable smell about them, and this is perhaps the reason why the flowers are not used for worship

or adorning the head. But it is grown in gardens for the beauty of the flowers.

The plant is propagated from seeds and cuttings.

The Chrysanthemum.

Ask the children to mention the flowers commonly used for adorning the head and for making garlands. They will mention the rose, jasmine, oleander and the chrysanthemum. The chrysanthemum is largely used when the rose and jasmine are not to be had. Elicit from them that this flower is had practically all through the year. But it is had in plenty after the jasmine stops flowering, i.e., from August to February or March.

Show the children the plant in the garden. Ask them how it grows. It grows to a bushy shrub full of green foliage. Let them examine the leaves which are of different shapes, with striated margins, especially at the end.

They are able to recognise easily the bright yellow flowers with the numerous petals. Let them find out if there are stamens. There are a few in the centre which gradually grow into petals. Is there a calyx? There is a round big one with numerous bracts. Pluck out the petals and show them that really these are single flowers with stamens and pistil, but a large number of them are found on a single head, presenting the appearance of one flower. If possible, show them a sunflower or a zinnia, in which they will note a similar arrangement of small flowers as a head presenting the appearance of a single large flower.

Tell them there are seeds inside the flowers which ripen. The plant is however generally propagated from cuttings and by layering. Talk to them of the several varieties of this flower.

Deal similarly with the sunflower (Fig. 42) with the large leaves, the zinnia with opposite leaves, cosmos and marigold. These are grown for the beauty of the flowers in the garden. They are not used otherwise. These plants are propagated by sowing seeds only.

The Shoe-flower (Hibiscus rosa sinensis).

Children probably know the flowers. Show them the plant in the garden with flowers. They would give you the name of the flower as "Semparutti". Elicit from them why it is called so. The flower is red and resembles the cotton flower. Ask them if they have seen other similar flowers.

Fig. 42. Sunflower. சூர்யகாந்தி.

They would mention the "bende" and the "portia". Tell them all these belong to the same family and have similar flowers.

Fig. 43. Shoe-flower. செம்பருத்தி or சப்பாத்திப்பூ.

Let them now examine the flowers and note that they are large, red or crimson, with large petals, and tubular calyx. Below the calyx there are also some leaf-like things. Draw their attention to the long peduncle or pedicel at the end of which the flower hangs like a bell. Pull out the stigma and show them the arrangement of stamens. How are the stamens arranged? Numerous stamens are arranged on a tube. Ask the children to crush the petals. What do they note? The flower is mucilaginous. The flowers are used in worship.

Let them now examine the leaves. The leaves are large, ovate, acuminated and coarsely toothed. The leaves are recognised easily.

There are different varieties of the plant. Show them the red, yellow, and white varieties if you have them in the garden. If not tell them about the different flowers. In a particular variety there are a number of petals, the stamens changing into petals. Do they see the flowers all through the year? The plant or shrub flowers all through the year.

The plant is propagated from cuttings and by layering, and not from seeds, as the fruits do not ripen to produce seeds.

Deal with the hollyhock, another similar flowering plant which resembles the bende in all respects, if this is found in the garden. The flowers are for ornamenting the garden and are not otherwise used. The plant is propagated from seeds only.

The Tulasi (Ocimum sanctum).

This is a nice little plant generally found in houses. It is considered sacred and specially liked by God Vishnu.

Show the plant in the garden and the children will readily recognise it from its fine smell, the branches with flowers, and the hairy growth on the stem and leaves.

Fig. 44. Tulasi. துளசி.

Let them examine the stem and the leaves and note the hairy coat all over. Let them observe the leaves which are with small petioles, oval and toothed.

Show them the flowers. Do they grow singly or in clusters? Numerous flowers are arranged on a stalk which grows erect. The flowers are small and insignificant, and pale purple in colour. There are small seeds inside the flowers and the plant is propagated from seeds. Let them examine the corolla of the flower. It is divided into two lips. Do they note

any difference between these lips and those of the thumbe? In the case of this flower, the lower lip is narrow and small, whereas the upper lip is big and four-lobed. The stamens project outside.

Which part of the plant is commonly used? The leaves and not the flowers. Talk to them about the stem of the plant being made into beads and worn round the neck. The plant's atmosphere is considered healthy and so it is grown in houses.

A similar aromatic plant is Ocimum basilicum, which may also be grown in the garden.

Marjoram is also used for garlands and worship. This is a similar plant, but it is propagated from cuttings.

The Rangoon creeper (Quisqualis Indica).

This is a shrub with beautiful flowers, generally allowed to grow over arches and bowers in the garden.

Fig. 45. Rangoon Creeper. ரங்கூன் மல்லி.

Show the children the shrub in the garden. Ask them how it grows. It is a creeper or climber and grows bushy. Let them observe how it climbs. Are there thorns or tendrils? No. It climbs up with the long branches entangled on the supports. Compare with the methods of climbing adopted by other plants previously studied.

Let them observe the leaves and the twigs. Do they note any difference between the young branches and leaves and the old ones? Young branches and leaves are densely pubescent, but become smooth and glabrous as they grow. Elicit from the children that the leaves are large, ovate, entire and are oppositely arranged. The veins are well marked on the underside of the leaves.

Draw the attention of the children to the flowers. They are red and white and in various shades of red. Are they found singly or in clusters? They are found in clusters hanging loose. Let them note the slender calyx tube and the corolla tube and the ten stamens protruding. Let them smell the flowers and note the slight fragrance.

Show the children the fruits if found on the shrub. Let them note the five-furrowed and five-angled fruits and the five-angled solitary seeds in them.

The plant is propagated from seeds and cuttings.

The Parijatam (Nyctanthes arbor-tristis).

This is a small tree fairly common in villages, giving beautiful flowers used for worship. It is also used to make garlands which are offered to gods.

Show the children the tree. Probably they know it already. Let them look at the young shoots and twigs. They are four-sided, but the older branches are round. Have they seen any other plant or tree with the young branches or shoots similarly four-sided? The guava.

Let them examine the leaves. Elicit from them that the leaves are short petioled, pointed, coarsely serrate, and very rough to the touch.

Show them the flowers. Let them smell them and note the fragrance. What peculiarity do they note about the flowers? The corolla is white but its tube is orange-coloured. When do the buds open? The flowers open at night and fall off very freely in the early morning, so that flowers are found

Fig. 46. Parijatam. பவளமல்லி or பாரிஜாதம்.

in plenty under the tree on the ground in the mornings. Let them note the small calyx cup and the embryo fruit inside.

The fruits are flat and circular. Let them open one and find out the two thin seeds.

The tree is propagated from seeds and cuttings. It flowers generally all through the year.

The Thangarali (Thevetia nerifolia).

This is one of the two shrubs or very small trees with conspicuous yellow flowers common in gardens. The other is "Swarnapatte" (Tecoma stans) usually called "Thangarali" in the vernacular. But the two are easily identified.

Show the children the shrub in the garden. The stem has a greenish tinge about it, and the leaves are green, linear, entire, almost veinless, smooth and grasslike. These grass-like leaves differentiate this shrub from the other shrub "Swarnapatte", which has lanceolate leaflets with serrated edges. Pluck a leaf and break a twig. What do the children observe? A milky juice flows out. Tell the children this is poisonous.

Fig. 47. Thangarali (Thevetia). தங்கரளி.

Pluck a flower and show the milky juice coming out. Let the children examine the flowers. Elicit from them that they are bright yellow in colour, situated on a five-cleft calyx and are funnel-shaped. Let them smell the flower and note the fragrance. The petals are united just above the tube, but free above. Generally flowers are found all through the year though in plenty from April to June. Can they find the stamens? No. Tear open a flower and show the short stamens inside the tube.

Let them examine the fruit, which is irregularly circular or elliptic in shape with ridges. Break a young fruit and let the children note the milk coming out. Ripe fruits are dark brown, and contain a stone-like seed chamber inside. Show them the seeds inside the hard stone.

The plant is propagated from seeds and cuttings.

The Swarnapatte (Tecoma stans).

Show the children the shrub or the small tree with the bright yellow flowers. Elicit from them the differences between this and the "Thangarali" (Thevetia nerifolia). The

"Thangarali" has linear grass-like leaves, bell or funnel-shaped flowers with the corolla tube opening wide into lobed petals. The whole shrub has milky juice. The fruits are irregularly round with ridges containing a stone-like seed

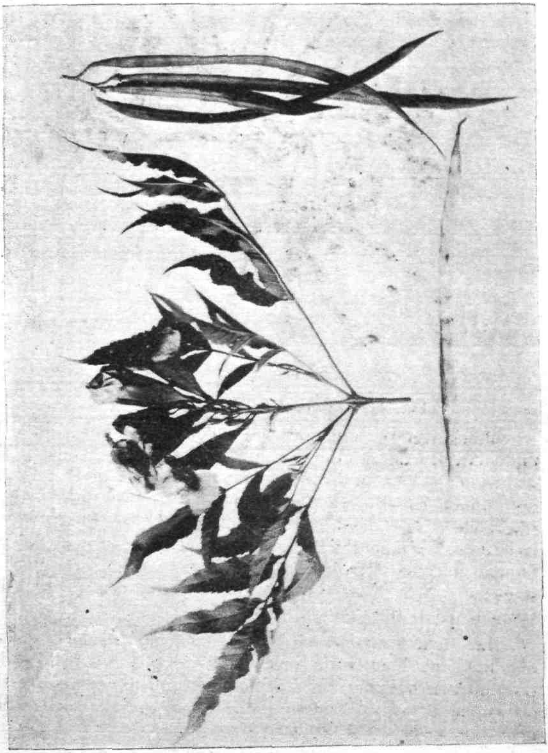

Fig. 48. Swarnapatte (Tecoma stans).

chamber inside. In the Swarnapatte the leaves are compound and the leaflets are arranged like a feather on the stalk. The leaflets are lanceolate and serrate. The flowers are trumpet-shaped with four developed stamens. Let the children see the fruits. They are long and thin with many seeds inside. Show

them dry fruits of the plant and fruits which have opened. Fruits dry and open along a line, exposing the seeds. The seeds are interesting. Let them examine them. What do they note? They are very thin, small and winged. Is there any advantage in this? Because they have wings the seeds are easily distributed by the wind. They have studied about the advantages of seed dispersal already.

Flowers are found in plenty during April to June. The plant is propagated from seeds and cuttings.

The Mundare (Bauhnia tomentosa).

This is common in gardens, and is generally a small, slender tree with grayish brown bark. The tree is easily recognised from the peculiar leaves.

Show the children the tree. Let them examine the peculiar leaves. Each leaf resembles the hoof of a cow or goat, deeply divided at the base and apex. Let the children feel the leaf. It is rough, with numerous radiating veins. Tell them each leaf really consists of two partly joined leaflets.

Fig. 49. Mundare (Bauhnia—Yellow). மஞ்சள் மந்தாரை.

The flower is attractive and light yellow in colour. Let the children smell the flower and note the scent. There are

five large, light yellow petals loosely attached. Draw their attention to the calyx in the bud and in the developed flower. The calyx is covering the entire bud and splits open when the bud grows to a flower. Is the calcyx cleft? What does it look like? It resembles a spathe though five-ribbed to show that it is made up of five sepals.

Show them the fruits which are green at first, turn brown when ripe and break open, scattering the seeds. The fruit is fairly long.

The tree is propagated from seeds. Cuttings also thrive if carefully treated.

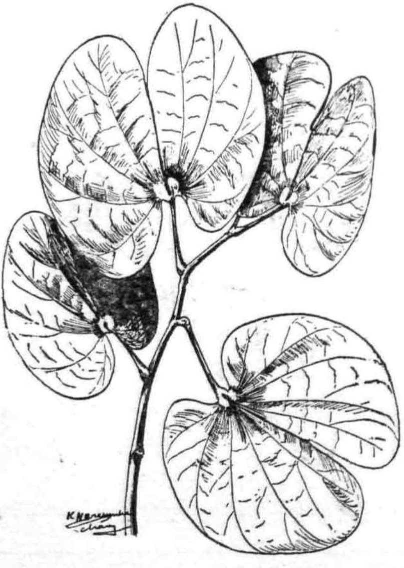

Fig. 50. Mundare (Bauhnia—Red). சிவப்பு மந்தாரை.

• A similar tree with scarlet flowers is Bauhnia purpurea. This is also common in many places.

The Mayil Konnai (Cæsalpinia pulcherrima).

This is recognised from the small ovate leaflets arranged

Fig. 51. Cæsalpinia. மயில் கொன்னை.

like a feather on the stalk, the red or yellow flowers on long stalks with small petals, and the beaked fruits resembling the double bean. There are small spines on the leaf-stalk.

The Sarakoṇnai (Cassia fistula).

This is easily recognised when in flower. The scented flowers grow in large, beautiful hanging clusters which may be even two feet in length. There is a five-cleft green calyx, and the five petals are pale yellow, elliptic and concave.

The long cylindrical black fruits with numerous one-seeded cells are also characteristic of the tree, and they aid us in recognising it.

CHAPTER 6.—COMMON FRUITS OF THE GARDEN.

The Pomegranate.

The children are acquainted with the fruit, and they can readily recognise the shrub when in flower and fruit.

Fig. 52. Pomegranate. மாதுளை.

Show them the shrub in the garden. Ask them if they have seen the plant growing large to the size of a tree. It is

generally a shrub or a small tree and never grows big. Let them touch and feel the branches. What do they notice? There are sharp spines. Let them mention other shrubs and trees with spines they have studied before. Tell them these spines protect the shrub from cattle as in the case of others with spines.

Let them describe the leaves. They are small, numerous and oblong, lanceolated with short petioles. How are the leaves arranged? They are opposite. Even after much acquaintance children can identify the leaves only when on the shrub.

Show them the flowers. They will be attracted by the big scarlet flowers. These seem to be "double" flowers. Show them the calyx which is thick and red. Is it entire, like a cup? No, it is cleft. Let them note the thin scarlet petals. How many are there? Are there stamens? How many? There are numerous yellow stamens. They can never forget these flowers.

Show them the fruit and cut it open to show the numerous seeds inside. The fruit is large, round and hard-shelled. What do they see at the end as a crown? It is the calyx that forms the crown. Explain to them how the embryo fruit is under the flower and hence the calyx is at the top of the ripe fruit as a crown. What did they note in the case of the brinjal and the chilli? The calyx was at the bottom of the fruit. Which part of the fruit do they eat? The seeds are covered with a pulpy matter, and they eat this pulp and spit out the seeds. Fruits are had all through the year.

Probably they know that there are two kinds of pomegranate, one sour and the other sweet. Tell them that the sour kind is good medicinally. The fruits are eaten, even tender ones, in cases of dysentery and diarrhoea.

The tree is mainly propagated from cuttings.

The Guava.

Children know the fruits and possibly the tree as well. Show them the tree in the garden. Is it a big tree? It is a small tree or big shrub and does not grow very large. Let them compare the size with that of the pomegranate. The guava grows somewhat larger than the pomegranate.

Let them observe the trunk. What peculiarity do they notice? The trunk and branches have a peculiar, smooth

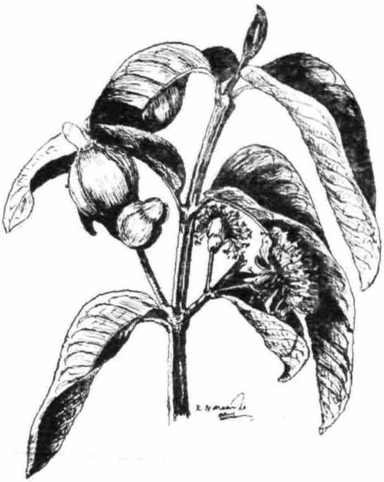

Fig. 53. Guava. கொய்யா.

greenish gloss, and the skin of the bark is seen peeling off. From this they can recognise the tree in future.

Let them take a leaf, feel it and examine it well. The leaves are numerous, large and elliptical, with short petioles and well-marked veins. The veins are rough to the touch. How are the leaves arranged? Opposite. Show them the small branches or twigs. What peculiarity do they note about them? They bear four small narrow ridges, giving them a square shape.

Show them the white flowers with the prominent green calyx and the numerous stamens. Which flower does this resemble? The pomegranate, except for the colour. Tell them that both belong to the same family, but spines are absent here.

Show them the fruit and the numerous seeds inside. Which part do they eat? The whole fruit. Show the calyx

fruits are green. Let them give the uses of the fruits for condiment and pickles. They are also used medicinally.

The plant is propagated from seeds.

The Custard apple.

The round, nodular fruit is familiar to the children, and they can recognise the shrub in fruits. Show them the shrub in the garden. Is it a big tree? This does not grow to a big tree.

Fig. 55. Custard apple. சீத்தா.

Show them the leaves and let them feel them. They look like guava leaves. What differences do they note between this leaf and the guava leaf? This leaf is smooth but the guava leaf is rough with prominent veins. Let the children squeeze a leaf and smell. There is a little disagreeable smell about the leaf.

Show them the flowers. What striking thing do they note about the flower? The flower has three greenish petals inserted in a small triangular calyx. Are the petals like those of other flowers? The petals are greenish yellow and are fleshy. Cut open a flower or remove the petals. What do they see inside? There is a white mass consisting of

numerous stamens. Let them smell the flower. There is a slight sweet scent about it. Can they suggest a similar flower with three greenish petals and similarly smelling? They would suggest the "*Manoranjitam*" *if they know the flower; if they* do not know it, tell them about it and show them a flower if found in the village; otherwise you need not mention this.

Show them the fruit. Cut it *open to show the* numerous seeds inside the carpels or chambers. Which part of the fruit do they eat? The pulpy matter around the seeds is eaten and the seeds are spat out. Only some people relish the taste of the fruits.

The Bullock's Heart is a similar fruit with a very similar shrub, but this grows larger to the size of a middle-sized tree. Treat this similarly.

The Wood-apple.

Probably you have not got the tree in the school garden. You may take the children to see a tree in the village.

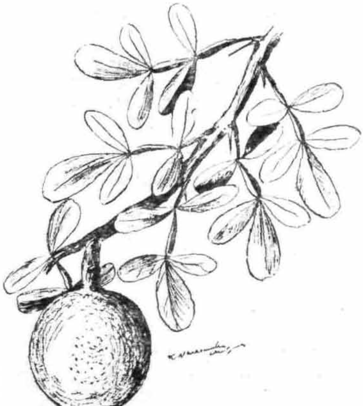

Fig. 56. Wood-apple. விளா.

Show them the tree and question them on its size. This grows to a big tree. Get a branch and show them. What do they note? There are spines on the branches. Let them look

at the tree. Ask them if any other tree is similar in appearance, having spines and producing similar fruits. They would suggest the Vilvam (Aegle marmelos) if a tree is found in the village temple or anywhere. Tell them that both are similar trees and belong to the same family. The fruits of the wood-apple are eaten because they are sweet, but those of the other are not.

Show them the leaves and let them observe. There are 5 to 7 leaflets arranged feather-like on the petiole. The leaflets are smooth and shiny. Do they note anything striking about the petiole? The petiole is winged. Children can identify the tree from the spines and winged petioles.

Show them the flowers. They are small, reddish in colour with large anthers, and grow in clusters.

The fruit is familiar to them. They know there are numerous seeds in the pulpy matter inside the fruit. By questioning elicit from them that the fruit has a hard shell covering, and that the pulp inside changes from white to dirty yellow and then to brown as the fruit ripens.

Show the gum found on the tree, and tell them this is used medicinally. The fruits also are considered good for throat complaints.

The Grape Vine.

A lesson on the vine may be taken, provided it is grown in the school-garden. It is fairly common in the Salem district.

Children easily recognise the plant after seeing it once. It is recognised by the tendrils given off by the plant for climbing, and the deeply sinuated leaf. They should carefully note the tendrils regularly growing opposite the leaves. The stem has a reddish tinge about it. Flowers are small and white. They grow in bunches or clusters. The fine bunches of grapes could not be forgotten by the children.

Grapes are eaten fresh and preserved.

The Plantain.

This is described under vegetables.

The *coconut*, the *mango*, the *jack* and the "*Naval*" (Eugenia jambolina) are treated under "Trees".

CHAPTER 7.—ANIMALS.

The Cow.

Take the children out to the neighbourhood or to the village maidan where cattle are grazing. Show them the cows and let them note that all cows are not of the same colour. Many are white, some red, some spotted, and so on.

Ask them why cows are tended by men and are so carefully looked after. The cow is a very useful animal. It gives us milk and from the milk we take curd and butter. Would they find cows in the adjoining villages and towns? They are found everywhere. In fact we could not do without them.

By suitable questioning lead the children to describe the general build of the cow. It is a large animal with short, strong, stout legs fit to support its heavy body. It has a thick skin to protect itself from hot and rainy weather. Its neck is thick, long and strong. How does the cow graze? Can it take the grass, water or any food to its mouth with its limbs as we do? No. It bends down and reaches the grass, water or bran with its mouth. Hence its neck has to be long enough to reach the ground when it is standing.

Draw their attention to the large mouth, broad ears and large eye. Make a noise and let the children note how the *animal directs its ears in the direction of the sound.* The ears can turn all round. What are the horns for? They will tell you that they are for defence. Tell them that the cow butts or attacks rarely, but tries to escape from dangers by running away whenever possible. It is by nature a gentle animal.

Get a cowherd near by to open its mouth and let the children observe this. Let them note the long tongue. They might be allowed to feel it or that of a calf. It is rough and bristly, so that the animal can scrape out things, such as bran, from tubs and pots. How does it clean or scratch itself? By licking with its rough brush-like tongue.

Let them look at the teeth. There are large front teeth in the lower jaw, but the upper jaw is hard and without these front teeth. Let them observe how the animal roots out the grass from the ground. The lower jaw teeth press the tuft of grass against the hard upper jaw, and with a jerk of the head the animal catches the tuft. The grass is crushed by the crushing teeth in both the jaws and swallowed.

Call attention to the long tail with the tuft of hair at the end. Children will observe the cow lashing its tail about its body frequently. Ask them why it does so. To drive away flies sitting on its body.

Let them look at the hoofs and feet. The hoofs are cloven or split into two parts. The hard hoofs help the cow to walk over all sorts of ground.

Draw their attention to a cow lying down in some quiet place in the maidan. Ask them if it is really resting. Let them observe that it is chewing something. Is it eating grass now? No. Tell them that all the while the animal grazes it bites off the grass and swallows it without chewing it well. The cow has a peculiar bag inside, into which all the grass is thrown. When this bag is full, it goes and lies down in a quiet place. It brings back the grass from the bag to its mouth, chews it well and swallows it. This is called *chewing the cud*. Show them, if possible, the ball of cud coming up through the neck. But we swallow our food after chewing it well, for we cannot get back what we have swallowed once.

Question the children about the food of the cow, and tell them that it is a strictly herbivorous animal.

Lead the children to talk about the uses of the cow. Tell them about the uses of its skin. Its bones and horns are made into combs, buttons and knife-handles. Cattle dung is a good manure. Some people eat the flesh.

Talk to them about the uses of the bullock or ox. It is very useful to us to carry loads, to drag carts, and to drag the plough in the field. Bullocks used for draught purposes are shod with iron to prevent excessive wear of the hoofs.

Similarly the buffalo may be studied.

The Sheep.

Take the children out to the field or maidan where sheep are grazing.

Ask them why men keep a number of sheep. Some drink the milk; some eat the mutton. Ask them what their blankets and rugs are made of. If they cannot answer tell them they are made of sheep's wool. Have they seen sheep and goats penned in fields? Can they tell why? The dung is a very valuable manure for the fields and gardens.

Now direct their attention to a sheep. By suitable questions, elicit the following: It is a smaller animal than the

cow. It is a quiet animal generally, but some male sheep have terrifying horns. It grazes quickly and chews the cud later. It has no front teeth in the upper jaw. It has cloven hoofs. It has a thick coat of hair or wool.

Explain how sheep are protected from cold weather by the woollen coat or covering. This coat is unnecessary and troublesome to them during the hot months. Men therefore shear the wool and use it in many ways. Tell the children how the wool is sheared, cleaned and is then made into rugs and blankets.

Lead them to talk about the food of sheep. They eat all sorts of plants and are a danger to gardens and fields. They are expert climbers. If hills are near by, they are generally led up the slopes to graze. They are fond of climbing and do it quickly and with ease.

The goat may be studied similarly. The goat is really the poor man's cow. It is kept for milk and mutton.

The skin of goats and sheep makes good leather for shoes and other leather goods.

The Horse.

Arrange with someone having a horse to show the children the animal. Horses are kept to draw carriages. Some men keep horses for riding.

Ask the children if they would prefer travelling in a cart drawn by a horse or in a bullock bandy. Why? The horse goes fast and a long distance without getting tired.

It is quiet and gentle at its work. It understands praise or rebuke from its master. What do the children understand from this? It is an intelligent animal.

Let them observe the build of the horse. It has a skin which is not so thick as the cow's, and the hair which covers it is soft, smooth and glossy. Ask them what they know about the colour of horses. They are of different colours such as white, brown, grey, black, and so on. Its legs are long and slender to enable the animal to run well. Who can run faster, a thin tall man or a stout short man? Similarly which can run faster, the bullock or the horse? Why?

Let the children observe the hoofs, which are not cloven. Talk to them about shoeing horses and bullocks to prevent the hoofs from wearing out. Compare the hoofs to our finger

and toe nails, and explain how these animals do not suffer pain when being shod.

Ask them to observe the neck. What peculiarity do they note? The name. Its neck is long to allow the animal to reach the ground while grazing or feeding. The horse often lashes its tail to drive away flies.

Draw their attention to the erect, small and sensitive ears. Let them note how the animal turns them to catch sounds. Request the owner of the animal to open its mouth and show the children. What do they see? Front teeth are found in both the lower and upper jaws. So the horse cuts the grass close with the sharp teeth. Contrast it with the cow in this respect. There are no horns. How does the animal defend itself? It will kick and occasionally bite.

Tell them how it is controlled by the reins and the bridle.

Lead them to talk about the food of the animal. It is herbivorous. It does not chew the cud as the cow, goat and sheep do.

Let them talk about the uses of the horse. The skin forms good leather. Its hair is used for stuffing cushions. Its bones are made into combs and handles of things. Its flesh is not generally eaten.

The Cat.

Cats are found in villages, growing as common property. Some people keep cats in houses. Procure a small kitten for the lesson. Get a dish of milk.

Ask the children if they keep cats in their houses. What for? To clear the house of rats and mice. Talk about the troubles caused by rats and mice. Let the children tell how the cat catches rats and mice. It lies asleep in the kitchen near the fire. It hears the slightest noise of the rats in the store room. Suddenly it rises, creeps towards the door of the store room and before even a few minutes have passed holds a mouse or a rat struggling in its mouth. So what is the cat fond of? Rats and mice. What else does it eat? It eats insects, rice, milk, curd and other things. Tell them it is primarily a carnivorous animal, but also eats rice and other food. Now put the kitten on the table. It mews. The boys know the characteristic sound. Put the dish with the milk before it. Let them note how the cat drinks by licking.

Ask the children to touch the kitten, stroke it, and observe the parts of the body as the fur, ears, face, eyes, whiskers, legs and claws.

The eyes are round and sharp-sighted. They have seen how keenly it watches and waits for the rat to settle, and how it crouches before leaping. Have they seen its eyes at nights? They look like glowing balls. Tel them that the pupils open wide when it is dark, and the animal is able to see even in darkness. How is this of advantage to it? Rats are active at nights and cats have to hunt after them only in the nights. How are the pupils in the day? Slit-like. Why? There is plenty of light and hence with even a small opening they can see well. But generally, it sleeps in a snug place like the chimney or near the fire in the daytime, and it begins its movements at night. Does the cat hunt after anything else besides rats and mice? Yes. It catches small chickens and eats them. It also goes up trees to steal the eggs of birds.

Let them observe the sharp claws. Lead them to understand how they help in climbing. Show the claws of the kitten. Let them observe how the animal is able to project and retract them. How sharp they are! Do the claws serve any other purpose? After killing its prey with a few bites, it tears it with the claws.

Let the children feel the feet. How soft and cushion-like they are! Do they notice any sound while the cat walks or jumps? No. These cushioned feet prevent any noise being made. Will not the claws make a noise? No, they do not touch the ground, for they are drawn in and concealed in the fold of the skin. What does the cat do if we tease it? It spreads its claws and scratches us.

Let them look at the long whiskers. Tell them there is a sense of touch in them. The cat can feel things with them. Gently open the kitten's mouth and show the children the sharp canine teeth. What are these teeth for? For biting and killing its prey. Did they notice these teeth in the cow or the horse? No. They are herbivorous animals and there is no need for these teeth. Show them the molar teeth for chewing.

Let them feel the tongue. It is rough and spiny. Tell them how the cat uses the tongue for lapping milk and blood and cleaning its soft fur. The cat is a fairly clean animal and does not allow any dirt on its body.

Tell them it is not a faithful animal. It tries to steal the milk and ghee of the house. In trying to catch rats and mice it upsets so many household articles and causes us inconvenience.

Tell them there are bigger cats in the forests and jungles which feed on larger animals such as cattle, sheep, and even men. They are the tiger and cheetah and the lion. If any children have seen some of these in a circus company, or town menagerie, those children may talk about them. Otherwise show a picture of the tiger, and compare it with the cat. Tell them that cheetahs and tigers are found in our forests but lions are found in Africa.

The Dog.

Procure a pup and a tame dog, if possible, for the lesson. Also have a small quantity of milk in a dish.

Begin the lesson with a chat about the animals studied already. Those are useful in different ways. The cow and the goat give us milk. The sheep gives us the material for our rugs and blankets. The cat is useful in getting rid of household pests such as rats and mice.

Ask the children why we have dogs in our houses. Does the dog give us milk? Does it give us wool? Elicit by such questioning that the dog is a good watch of the house, a playmate of children and a faithful companion of its master. Shepherds keep dogs to protect their flocks from jackals and to keep the sheep together.

Lead them to talk about the way in which the dog guards the house. It knows its master and the people of the house. When a stranger enters the house, it understands his approach or presence by its sharp ears and keen sense of smell. It barks and lets the master know of the arrival of the stranger. When the master begins to talk to the person or welcome him, the animal readily understands the situation and keeps quiet. At nights it hears even the slightest noise and immediately begins to bark and chase the stranger or thief. Let the children talk about the lasting affection and the ready obedience of the dog to its master. Tell some stories to illustrate this. Also tell them that whereas the dog is faithful to the master, the cat is faithful to the house.

Ask them if all dogs are alike. You may not have different kinds of dogs in the village but you may show the children

pictures of these if available. Some dogs are shaggy, some have broad hanging ears, some have long and pointed faces, and so on.

Let loose the tame dog with you. It probably begins to smell about the room. Tell the children that its sense of smell is very keen. It is only by this keen sense of smell that it is able to follow the tracks of animals.

Let the children observe its legs. They are slender but strong. These legs enable the animal to run swiftly. Let them look at the paws and claws of the pup. The paws are padded underneath as the cat's, but the claws are blunt. Do they hear any sound when the dog walks or runs? Yes. Do they hear the sound when the cat walks or runs? No. Why? The dog cannot draw its claws back but the cat can. The claws of the dog touch the ground always and get blunt. The noise of the claws is heard when the animal walks or runs.

Show the mouth of the pup. The tongue is thin, moist and long and the teeth are sharp. There are sharp canine teeth also. Which animal had such teeth? The cat. What sort of food will the dog eat? The dog is primarily a carnivorous animal but it also eats rice, bread, etc. It is fond of bones. Put the dish of milk before the pup. It licks it up. Let the children feel the tongue. It is smooth and not rough like the cat's.

Tell them that dogs are useful animals as seen already. But they become a source of danger to man when attacked by hydrophobia. Tell them how dangerous it is to be bitten by a rabid dog. In cases of rabid dog-bites, they have to go to the Pasteur Institute, Coonoor, for free treatment.

There are wild dogs, and they are the jackals, wolves and foxes. These howl at nights in the backyards of our houses. Tell the children that the fox is said to be a very cunning animal. You may tell some stories illustrating this.

The Squirrel.

Take the children to the garden and show them the squirrels in the trees. Pick up a few fruits from the ground which have been partly eaten by the squirrels and show these to the children. Ask them who ate these fruits. They will say "the squirrels". They are mischievous animals, and spoil the fruits in the garden. Let them say how the fruits are protected from squirrels. In large gardens they are covered with wire and metal or tin cases. Show them such protections.

Where does the squirrel live? It lives in nests built in trees. We find sometimes squirrels nesting in holes in the roofs of houses. Let them observe the movement of the squirrel on the tree. Does it walk, run, or crawl? It jumps quickly from one place to another. It can grip well the boughs with its toes. How does the cat climb up a tree? It holds itself to the tree with its sharp claws. Similarly the squirrel also has sharp claws with which it hooks itself to the bark of trees. It climbs with agility.

Let the children observe its tail. It is long and bushy. The animal can hear well with its ears and see with its sharp eyes.

Ask the children what it eats. It eats fruits, nuts, seeds, young juicy shoots and even the bark of trees. Show the children a fruit partly eaten by a squirrel. What do they see? There are chiselled markings made by the squirrel's teeth. Have they seen other animals eating like this? They may suggest the rat. If they do not, recall to their memory how nicely rats and mice eat the coconut kernels at home. Tell them that rats and mice belong to the same family as the squirrel and they are similar in habits.

Make the children talk about the enemies of the squirrel, such as kites, owls, etc. Even men drive them away from fruit gardens. Tell the children that squirrels and rats increase rapidly in numbers and cause us loss.

Other animals of the same type are bandicoots and rabbits.

The Domestic Fowl.

Procure a hen, an egg and a few grains of rice.

Children have seen from their infancy the cock and the hen and they can distinguish the two. Show them the cock and the hen scratching the ground in search of food. Question them on the differences between the two. The cock is larger than the hen and has a brilliant plumage. It possesses a larger comb on the head and larger flaps on the beak than the hen. Let the children look at the tail-feathers of the two. What differences do they note? They cock has some sickle-shaped tail-feathers overhanging the curved tail.

Let them observe the birds walking. They walk gracefully, quickly protruding their heads at every step they take. Drive them away. What do they do? They run

quickly and probably fly a little. Ask the children what differences do they note between the flight of these birds and that of the crow and the sparrow. The fowl's flight is slow and somewhat awkward. Let them observe the wings and the legs. The wings are short and not big enough to enable it to fly well. But the legs are strong and well developed. So they are able to walk and run well.

Show the children the claws of the fowl. There are four claws and they are blunt and slightly bent. As it walks along, it goes on scratching the ground with the claws and picking up something with its beak. What does it pick up and what does it eat? It eats worms, small insects, grains and seeds. Now put grains before the bird. Let the children observe how the bird turns its head and sees even the smallest grains on the ground, picks them up and swallows them.

Lead the children to talk on the chief habits of the fowls. The cocks begin to crow at about half past four in the morning telling us of the approach of the dawn. The crows begin to caw an hour later just at dawn. People begin to travel or go to the fields for work when they hear the cocks crow. Ask the children if they have heard the hen crow. No. The hen makes the peculiar "cluck! cluck!" sound, and never crows like the cock.

Ask them why we keep fowls at home. For the eggs and flesh. Many people eat eggs, for they are a very nourishing food. Many eat the flesh of fowls. The children would probably be able to give information as to the number of eggs laid at a time, the number of eggs laid by a hen in a year (about 80), and so on. What does the hen do after laying the eggs? It sits on them, warms and hatches them. Tell them, if they do not know, that chickens come out of the eggs after about three weeks. Who feeds these chickens? Are they fed by the mother as is the case with us, the cow, dog, cat, etc.? No. The moment the young chickens come out of the eggs, the mother leads them about, and they quietly follow her and pick up their food. Tell the children that if it were not for this characteristic, the hen would be unable to feed so many young ones. Let them contrast this with the crow. They would have seen the mother-crow picking up food and putting it into the mouth of the young ones. Draw their attention to the fact that the *cock* does not concern itself with the bringing up of the young ones. What do they notice in the case of the crow and the sparrow? Both the father and mother birds are aways seen together in building nests and in feeding the young ones.

Fowls may be allowed into the gardens to pick up worms and harmful insects. They should not be allowed near seedling-beds as they eat the seeds, pick up the young seedlings and thus damage the beds. When scratching the beds in search of worms and insects they uproot the young seedlings.

Tell the children that the turkey and guinea fowl belong to this class of birds. Also the peacock is of this class. Let the children say which has those beautiful eyed-feathers, the peacock or the peahen.

The Crow.

All children have seen the crow and are acquainted with some of its habits. Talk to them about the habits of the crow. It is a regular nuisance, entering houses and stealing whatever it finds. Refer to the belief that the crow foretells the arrival of guests by its persistent cawing.

Fig. 57. Crow.

Ask the children if all crows are alike. No; there are two kinds—one slightly bigger than the other and of a black colour; the other is a little smaller and has a light ashy-coloured neck. Ask the boys which is more common. The gray-necked one is more common. Give the names now—the jungle crow (கண்டங்காகம்) and the house crow—and tell them that both are alike in habits and way of living.

What do crows eat? Let the children answer first. Then supplement their answers. Flesh of animals (recall to them crows carrying away dead rats, mice and bandicoots thrown in the street), decayed matter, waste of all kinds, remnants of man's food, rice, etc. They also eat insects such as ants, beetles and grasshoppers. They sit on cattle and pick up ticks and eat them. They eat even small birds and their eggs. The boys have seen how they peck mangoes and other fruits with their beaks. Recall to their minds how boys wait quietly under mango trees for the crows to drop the fruits.

Ask the children to contrast the flight of the crow with that of the fowl. The crow flies well and quickly. How is it enabled to do so? It has large wings. Now let them look at the legs and the claws. The legs are strong and are provided with bulnt claws. What do they learn from this? the Bird can also walk well. The claws are useful for holding on to branches. Ask the children to observe how this bird also scratches the ground with its claws in search of food. Its beak is strong and sharp-edged, and hence it is useful to pick up things, break nuts and eggs and tear off flesh.

They have sometimes seen crows picking up food and putting it into the mouths of other crows. Let them explain what this is. The parent crows give food to the young ones. Did they notice such a thing in the case of the house fowl? No. Can they find out which are the baby crows? It is rather difficult to find out because the baby crows which have come out of the nests are more or less of the same size as the parent crows. But the young ones are generally duller in appearance, and are unable to fly rapidly and a long distance. When they caw, the mouth appears somewhat redder than that of the full-grown crow.

Who provides them with nests? Do we make any arrangement for the crows to rest and lay eggs as we do in the case of the hen? No. Crows build their own nests. Show them a nest near by. The nest is built in a tree with twigs and it is lined with bits of dry grass or straw. Tell them that the crow lays four or five eggs, and show them an egg if available. Place this egg in the museum.

Now tell the children that crows are a nuisance in houses but are very useful to farmers. They eat all sorts of injurious insects and grubs in the field and garden and thus save the crops. Show the children how crows follow the plough and pick up insects.

The House-sparrow.

This bird is associated with our dwellings and is found nesting in houses. The boys would have noticed the nests in their houses and in the school building.

Let the children observe the sparrows. Are they all alike? No. There appear to be two kinds. One has bright plumage with the head, eyes and chest black, and tail reddish brown; the other has no black mark or spot, but the upper plumage is brown with reddish streaks, and the under plumage is ashy white. Tell the pupils that these two kinds are the two different sexes. The one with the black spots and brighter plumage is the male and the other is the female. Ask them what they noted regarding the plumage of the cock and the hen in the case of the domestic fowl. What did they notice in the case of the crow? They could not differentiate the male from the female. Tell them this is the case with a few birds.

Have they observed how the birds build their nests? Both the male and female work together; they carry straw, dried grass, feathers, cotton, etc., and construct the nest. Show them the inside of the nest, if possible, and let them see that it is lined with soft material. Where do they generally build their nests? The children will tell you of several places in their houses where they have seen the nests, such as holes in walls, wells, interspaces in rafters and beams, holes between tiles, and so on. Show them the nest you have in view, and the small eggs if found.

Let the children talk about its habits. Are sparrows useful to us? No, they cause us all sorts of nuisance and annoyance. They come into the kitchen and pick up anything. They build their excreta. Tell them it is generally called and "aerial their excreta. Tell them it is generally called an "aerial rat". Let them explain why.

What does it feed upon? It feeds upon grains chiefly and also upon grubs and insects. Put a few unhusked grains of paddy or wheat before the bird. How does it eat? Does it eat the whole grain? It unhusks the grains with its short, strong, thick, conical beak and the husks are left behind. Tell the children how they eat the grains when we dry them in the house and spoil them by spreading and scattering them here and there. Ask them if they have seen the young ones before they come out of the nest. Probably some children have tried to catch them. Thell them they should not do this:

it is bad to injure the helpless birds. How do the young ones get their food? Do they pick up the grains like the chickens? No, the baby sparrows, like the young crows, are helpless and are fed by the parents, who bring caterpillars, grubs and insects to the nests to feed their babies.

Let them look at the way in which the bird walks and flies. It does not walk, but hops. It flies very quickly, and hence the name "sittu kurivi" in Tamil. Ask the children to look at the legs and the toes. The legs are slender, with three toes in front and one toe directed backwards. Tell them that this arrangement of the toes is well adapted for perching on branches and twigs.

Tell them the sparrows are injurious to the crops and are a nuisance in houses. The best way to get rid of them is to put a stop to their nesting from the beginning. They should not be tolerated in gardens and fields. The children of agriculturists will tell you how they drive away sparrows from gardens and fields, and why. Lead them to talk about this.

The Pigeon.

Procure a tame pigeon and a few millet grains. Pigeons and doves are found wild, but pigeons may be more common in some places and doves in others. Some people keep pigeons and breed them. They are introduced in temples and mosques, where special cells are constructed for them to rest and breed. If pigeons are available with anybody or in the temple, you may take the children there for the lesson; otherwise the lesson may be given with the tame pigeon before the children.

Fig. 58. Pigeons.

Ask the children to observe the birds. What colour are they? They are of different colours such as ashy gray, bluish, black, white and so on. The wings are long and pointed, reaching as far as the end of the tail. These wings enable the birds to fly rapidly. Let them look at the legs and the beak. The legs are strong, but the beak is small and weak. The beak is used only to pick up grains, but it cannot be used to crush or unhusk the grains. The grains are swallowed whole.

Throw the millet grains before the tame bird. Let the children note how rapidly it picks up the grains and swallows them. Tell them that pigeons and doves are herbivorous and feed on grains mostly. Are they useful birds in the garden? No. They visit gardens and fields in numbers and damage the crops.

Show them the eggs of the pigeon if available. It lays only two eggs at a time. Tell them that the young are helpless and have to be fed by the mother. The pigeon would not therefore be able to rear more than two birds at a time.

Tell the children how some people domesticate and tame pigeons and doves to catch wild ones. Also tell them that there are many kinds of pigeons and doves, such as the rock pigeon, green pigeon, ring-dove, etc.

The Kite.

A fish or two may be kept ready to be thrown to the bird.

This bird is often seen flying about villages near tanks and riversides in search of food. In tanks and rivers where men fish, and near market places this is sure to be seen.

Take the children out to a place where the bird is seen flying. Let them observe how it flies. It circles high in the air and makes the well-known squealing call. Ask them if all kites are similar. No. There are two kinds: one has the head, neck and abdomen white with thin brown streaks, and its wings are brownish-red; the other is deep brown on black all over. The boys may know the names of the two kinds—the Brahminy kite or Krishna Parundu, and the Pariah kite or common Parundu. Ask them if they know anything sacred connected with the Brahminy kite. This is held in reverence by the Hindus because it is said to be the "Vahana" or the carrier of Vishnu.

Now throw the fish with you in the air. Let the boys note what happens. The bird goes on circling and quickly perceives its prey. It approaches it rapidly and swoops down upon it head foremost. The bird has very keen eyes. It is able to see the smallest thing on the ground even from a great distance. Let the children watch what the bird does and how it carries away the fish. In an instant it seizes the fish firmly with its long and powerful claws. It goes to the topmost branch of a high tree and sits there with its prey. If the fish be a big one, the bird tears it with its claws and swallows it. Tell the children that small animals, such as mice and small fish, are swallowed whole. But bigger animals, such as fowls, are torn to pieces before being swallowed. Kites also eat crabs, grasshoppers and other insects.

Tell the children these are useful birds to gardeners and cultivators. But they often carry away chickens, and we have to be careful. Kites build their nests on the tops of lofty trees.

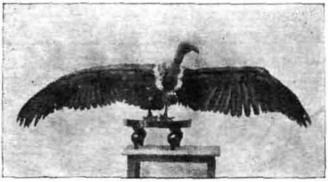

Fig. 59. Vulture.

Tell them that there are bigger birds of this sort rarely seen, such as the eagle and the vulture. These feed on human and animal flesh, and frequent burning and burial grounds.

The Mynah.

These birds are very common everywhere and are seen in numbers. There are two kinds of mynahs; the one is deep brown with black head and tail and with white underside, and the other is bluish gray in colour with black head and tail. Both the kinds are much the same in shape, size and habits.

Show the children the common mynahs sitting on the grouhd. What do they do? They go walking along, picking

up insects from the ground. They feed upon worms and small insects. They are also seen sitting upon cattle to pick up flies and ticks from their bodies. Let the children note the chattering noise made by these birds.

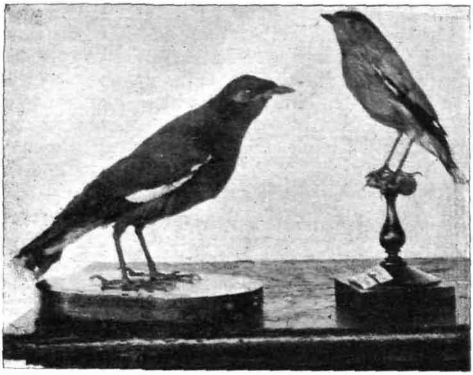

Fig. 60. Mynahs.

Let them describe the parts of the bird. The feet and beak are yellow, back and wings deep brown, and the head and the tail black. Let them look at the wings as the bird flies. What do they notice on the wings? White bands are seen on them.

Tell them that some people tame mynahs and keep them in cages at home owing to their capacity to imitate the human voice. Show them these tame birds if they are available in the village. But tell them it is unkind to tame wild birds and keep them in cages.

The other mynah is the Brahmin mynah, and its habits are similar to those of the common mynah. This also talks well and is a cage-bird. It is not so common as the other kind.

Mynahs are useful birds to gardeners and cultivators, as they feed on harmful pests such as grasshoppers, caterpillars, beetles, etc. They occasionally eat grains also. But they do far more good than harm.

The Drongo.

This bird is often seen sitting on a bare branch of a tree or a telegraph-wire. It is also seen sitting upon the backs of cattle grazing, to pick up insects and ticks.

Fig. 61. Drongo.

Take the children out to some place where this is found and show them the bird. Once they see the bird they could never forget it. Let them now describe its general appearance. It is jet black in colour from head to tail and has a long, forked tail. Have they seen any other bird with such a forked tail? No. So they can easily recognise the bird.

Let them now watch the bird sitting on the branch of a tree. What does it do? It surveys the surroundings and watches and waits for an insect to pass by. On seeing one, it suddenly leaves the branch, dashes after the insect, catches it and returns to its perch. Tell them it is an insectivorous bird and therefore it is a useful bird to cultivators. It saves them much loss from insects. Tell them that sticks may be stuck here and there in gardens and fields to form perches. The drongo will sit on them, watch over the crops and fly after the insects seen. Thus the bird will protect the crops by devouring the harmful insects.

Let the children note the whistling of the bird and try to imitate it.

The Bee-eater.

This is another useful bird often seen sitting on telegraph-wires or bare twigs of trees.

Fig. 62. Bee-eater.

Show the children the bird. Let them describe its general appearance. It is a beautiful, green bird with copper-coloured head and wings. Its tail is long and the two middle feathers of the tail extend beyond the rest.

Let them watch what the bird does. It waits patiently for an insect to fly in the air, darts out after seeing one, seizes it and returns to the perch to wait for another one. It continues to do so for hours and devours a number of insects. It eats bees largely, but eats also other insects. This bird and the drongo rarely come down to the ground to pick up insects.

Tell the children that these birds should be treated with kindness as they are useful to us in destroying insect-pests. Perches may be placed in gardens and fields for the birds to sit upon and do us the service of destroying insects.

The Babbler.

Babblers are very common everywhere. They are of a gray or earthy colour, and move about in flocks.

Fig. 63. Babbler.

Show the children the birds. Let them describe their general appearance. After seeing the birds once, the children would not forget then. Let them note the chattering noise made by the birds as if they are talking to one another. They hop about on the ground in search of insects. They are generally fond of turning over dead leaves in search of small insects.

These are also useful birds as they are insectivorous.

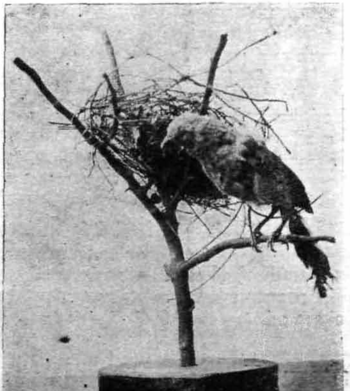

Fig. 64. Babbler and Nest.

The Swift.

These small, apparently headless, birds are seen flying in numbers in the evenings. When flying they often utter a screaming call. These never descend to the ground, but always keep flying. They catch and swallow small insects in the air as they fly. They can keep on flying for a number of hours without getting tired.

Fig. 65. Swift.

Tell the children that these birds cannot perch anywhere as all the four toes are pointed forwards. So when they are not flying they rest in nests built on the walls of ruined buildings.

These are useful birds also.

The Coppersmith.

These are very common birds, and their presence is known by the characteristic metallic call, "tong-tong-tong," repeated at intervals.

These are no larger than sparrows. The body, wings and tail are yellowish green, and the head and the throat are

Fig. 66. Coppersmith.

coloured brightly. The head and the neck are crimson. A black mark runs from the beak to the side of the neck. Let the children look for the birds with care in the direction of the sound. After seeing them once they cannot forget them.

Fig. 67. Coppersmith and Nest.

These feed upon the fruits of ficus trees chiefly. They also eat other fruits and occasionally insects.

The coppersmith is not of much value to us.

The Kingfisher.

This is a very handsome bird, and the pupils can easily recognise it from its brilliant metallic blue body and the large beak.

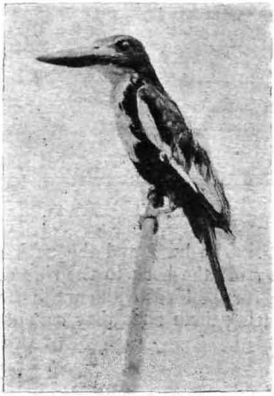

Fig. 68. Kingfisher.

Take the children to a riverside or tankside where the bird is found. Question the children on the appearance of the bird and elicit from them the following :—

The upper side of the body is brilliant blue in colour; the lower side is orange brown; chin and throat are white; feet brick-red and beak deep brown.

Ask them where they generally see the bird, and why. The bird is found on all sorts of vegetation near ponds, rivers and stagnant sheets of water. Its food which consists mainly of fish is available here. Let the children watch the bird catching its prey. It sits motionless on the perch and waits for fish and crabs to come to the surface of the water. It sees something (a fish) coming to the surface. It waits for an opportunity to catch it. It darts sharply towards the water

and dives into it head foremost. Then it comes out and flies up to the branch. It holds the fish in its mouth and swallows it calmly.

Tell the children that this bird is of neutral value to us as it does not frequent gardens and fields. It does not eat the insect-pests. Occasionally it comes to wet lands to swallow the crabs found there.

The pied kingfisher, with white body spotted brown, and with black beak, is also common. This is similar in habits to the common blue kingfisher.

The Hoopoe.

This bird is easily recognised by the long and thin bill and the crest of feathers on the head. It frequents places where rubbish and manure heaps are found and pastures.

Fig. 69. Hoopoe.

Show the children the bird. What does it do? The bird goes on inserting its bill into the soil. Tell the children that the bird searches for grubs, termites and other insects. It feeds on insects, and hence it is a useful bird.

Let the children describe the general appearance of the bird. The general colour of the plumage is brown; wings and tail are black, transversely banded with white. The crest of feathers on the head is spread out when the bird is frightened

or when it has just alighted on the ground after a flight. At other times it is folded.

The bird should be welcome into our gardens and fields as it destroys the insect-pests.

The Parroquet.

This beautiful bird is found visiting fields in numbers. Children are able to recognise the bird by the green plumage and the rose ring round the neck.

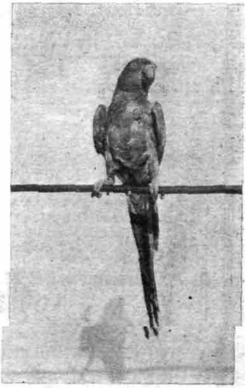

Fig. 70. Parroquet.

These birds often get into cultivated fields and pilfer the ripening ears of corn. They also eat fruits and nuts in gardens.

On account of their beautiful plumage and their capacity to imitate the human voice they are sometimes caged and tamed. But it is not at all kind to put them in cages.

They fly swiftly, making a characteristic call. They climb up trees rapidly. The curved strong beak is useful to crack nuts and to hook to the bark while climbing up trees. It has two toes directed forwards, and two backwards, to enable the bird to climb up trees. Explain this well.

These are harmful birds to cultivators and gardeners.

The Koel.

This bird is fairly common everywhere, but we rarely get a sight of it on account of its shy habits. Its presence is made known by the characteristic musical call, "Ko-el—Ko-el" or "Cu-ho—Cu-ho." The bird is found on roadside trees and on bushy trees in and around cultivated areas. It generally frequents ficus trees in fruit.

Fi.g 71. Male Koel.

Fig. 72. Female Koel.

Take the lesson when the bird can be seen. If possible show the children the male and the female koels. The male is of a shiny blue-black co!our and the fer.ale is dark-gray with white spots. It is the male that is more often seen. The bird is smaller than the crow, and has a long, rounded tail.

Tell the children that it feeds on fruits mainly. It is not a useful bird. Its melodious call is, however, attractive.

Tell them about the peculiar parasitical nature of the bird regarding breeding. It does not build a nest of its own, but lays its eggs, generally in crows' nests. The innocent crow hatches the eggs and brings up the young ones until they are able to fly. Then these young ones desert their foster parents and fly away. It so happens that the keol's eggs hatch

out early, and often the young ones eject the young crows from the nests.

Another bird of this class is the crow-pheasant. This is larger than the koel and is somewhat like the crow in size and build. The tail is long and rounded at the end. Its wings are reddish brown and the rest of the body is bluish black. This is also very shy and one rarely sees it. The peculiar note of the bird, "hoot-hoot-hoot", is commonly heard in and around jungles and bushy areas near cultivated fields. The bird is fond of bamboo clumps.

The crow-pheasant is an insect-eating bird.

The Woodpecker.

The golden-backed woodpecker is common everywhere. But it is not frequently seen, so that we cannot be sure of showing the children the bird at a particular time. The lesson is best taken when the bird is seen by chance. The teacher should therefore be ready with the lesson at any time.

Fig. 73. Woodpecker.

The plumage on the upper back is golden yellow. The head and crest are crimson and the lower tail and back are black. The feathers of the wings are black and yellow. Trees provide the bird with food, resting place at night and a nesting place as well.

Let the children observe what the bird does. It climbs up the tree step by step. It does not hop up. Tell them it is a climbing bird and it has two toes directed forwards, and two backwards. It hooks itself to the bark of trees with its claws as it climbs up. Ask them to note its pecking or hammering at the bark. Tell the boys that it feeds upon all kinds of insects and larvæ which burrow in the bark and wood of trees. It also eats ants found on the trees. Call attention to the strong beak which acts chisel-like in making holes in the bark, in peeling off and splitting open bark and wood.

This is a useful bird. It should be welcomed into our fruit gardens.

The Paddy-bird.

This is a common bird found near ponds and marshy places and in paddy fields and wet lands.

Fig. 74. Paddy-bird.

Show the boys the bird sitting. They may not see the bird immediately as its dull grayish colouration does not stand

out from its surroundings, and we can see it only after looking intently. Disturb a bird. It flies, making a display of its white body and large white wings. The upper plumage is grayish, but the lower plumage is white.

If possible, show the children the bird sitting silently and catching fish or crabs. Ask the children why it is seen near ponds and paddy fields. Its food is had here. It lives on fish and crabs mainly. It stands perfectly motionless, like a statue, in the shallow water. When it sees a fish or crab, it stretches its neck and thrusts into the water its long beak. The fish or crab is caught and swallowed. Which other bird lives on fish? The kingfisher. What differences do they note between these two birds regarding the way they catch their prey? The kingfisher flies over deep water and catches its prey. But this hunts only in shallow water.

Ask the children to look at the long legs of the bird. They enable the bird to walk with ease over soft, marshy places without wetting its plumage.

This is a useful bird in paddy fields where young seedlings are cut off by crabs. The bird is shot and eaten by some people.

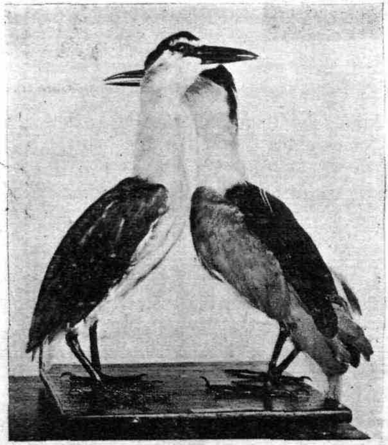

Fig. 75. Night Herons

Other similar useful birds are the common Night Heron, somewhat larger than the Paddy Bird, and the Cattle Egret. Cattle Egrets are seen in flocks. They follow cattle grazing to pick up insects disturbed by them. They are often seen *riding on cattle and picking up insects and ticks from around* their ears and eyes. The night herons build nests on lofty

Fig 76. Cattle Egret.

Fig. 77. Blue Jay.

trees such as the palmyra and the wild date palms. They make a peculiar "cluck-cluck" sound. They spend the day near ponds, fields and marshy places in search of food.

These are useful birds, and are shot and eaten by some people.

The Blue Jay.

This is a fairly common bird, but it may not be possible to see it at a fixed time. You cannot take the children out with the idea of positively showing them the bird. The lesson should therefore be taken when the bird is seen by chance. (See Fig. 77.)

The bird can be recognised by its characteristic blue colour. Show the children the bird perching on the branch of a tree or a telegraph-wire. What other birds do they see

sitting similarly? The drongo and the bee-eater. What were they sitting for? To catch insects flying in the air. Tell them this is also sitting for the same purpose. It is fond of flying white ants, crickets, grasshoppers, etc. It also occasionally gets into fields to eat these insects.

This is a useful bird.

Let them observe the bird and describe it. Its head, breast and back are bluish brown, and the wings and tail are brilliant blue.

Let the children note the noisy chatter of the bird. It often leaves the perch to catch some insect and returns to its place after catching it.

It may interest the children to know that the blue jay is caught for its feathers, which are used medicinally for cattle.

The Sun-bird.

This is quite a common bird, which frequents shrubs and trees in flowers.

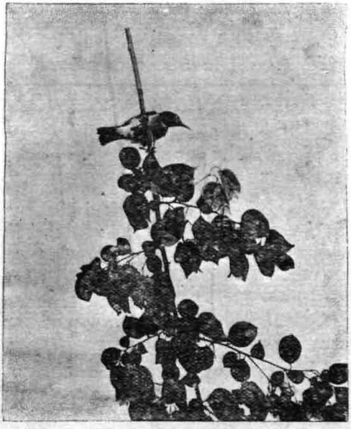

Fig. 78. Sun-bird.

Show the children the little birds hovering in the air in front of the flowers. Let them observe what the bird does. It puts its long, curved beak into the flowers, one after another.

Tell them the bird primarily feeds upon honey in the flowers. It also eats the small insects found in the flowers.

. Let them observe the bird and describe its appearance. Its upper plumage is light green and the under plumage is yellowish. Its tail is bluish black. This is the female bird. The male bird is of a metallic blue colour all over its body.

The Tailor bird.

This is seen in hedges and gardens. Its general colour is greenish yellow with red eyes. The tail is cocked up. The presence of the bird is known by its sustained ringing call. This call is very often heard near hedges and in gardens.

Fig. 79. Tailor bird.

Tell the children that this bird is very useful to horticulturists because it preys upon the minute insects that are not visible to the average-sized birds.

Show them a nest if available. Two or three small leaves are sewn together with some fibre and made into a nest. The interior is lined with wool or bits of cotton.

The House-lizard.

Procure one or two living lizards in a glass jar. These may be released after the lesson.

Show the children the lizards. They are able to recognise them. Ask them where they are found generally. They are found in houses, on trunks of trees and also on rocks. When do they see the lizard at home? It is seen more at night,

especially near lamps or lights. Why? Mosquitoes, small moths and other insects fly near the lights and the lizard catches and devours them. The lizard is insectivorous and helps us to some extent by devouring large numbers of insects which annoy us a good deal. Have they seen the lizard coming out in the daytime? Show them one under the rafter or behind the clock in the school. It comes out occasionally in the day-time to catch insects, but retreats again to its hiding place as soon as it has seized the victim.

Let the children observe the general build of its body. It has sharp, glittering eyes. It can also hear well with its small ears seen as dark spots on the head. The lizard runs rapidly along the ground in jerks with the aid of its short legs. Ask them if they have seen the lizard running about on vertical walls and even on the ceiling with its body upside down. How is it possible for the animal to do so? Show the children the toes and sharp claws. These sharp and hooked claws enable the animal to run about walls and move on the ceiling. Have they seen it sometimes falling down from the ceiling or rafter accidentally? Is it hurt? No. When it falls it keeps still for a moment and it is afterwards lively and active.

Show the children the small white eggs of the lizard. Tell them that young ones come out of them. These young ones are not fed by the parents, but they seek their food independently. The parents take no care of the young ones.

The house-lizard is small and generally colourless or of a grayish colour, but the lizards on trees and rocks are large, and are gray and brown coloured.

Tell the children that the lizard is a timid animal. The tip of its tail is easily detached if we touch it, but it grows again. This enables the lizard to escape from its enemies.

The Blood-sucker.

Take the children out to a hedge or garden and show them the blood-sucker found there. They can readily recognise the animal.

Let them describe its general appearance. It has a broad body with rough scales covering it. What do they note on its back? There is a crest-like comb. Its tail is long and thin. Disturb the animal. It runs quickly and climbs up the tree. Let the children note the legs with the sharp claws. By means of its sharp claws it can hook itself to the bark and climb up trees.

Show them the animal basking in the sun. It likes the warm sunshine. On the approach of danger it bobs its head up and down defiantly. But it is a timid animal and runs away at the approach of anybody.

Tell the children blood-suckers are quite harmless to us. They help us by destroying some of the injurious insects in gardens.

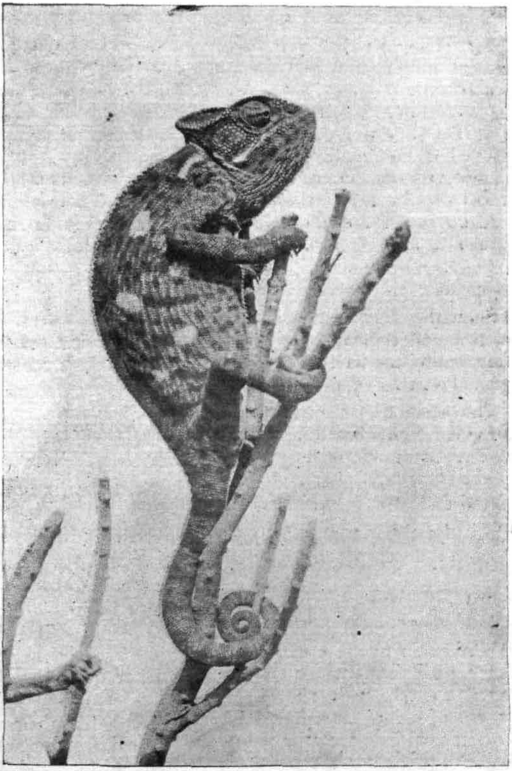

Fig. 80. Chameleon

The Chameleon is a kind of blood-sucker. This is not frequently seen. It has a peculiar, gummy tongue which it can protrude at great length to catch insects at a distance.

Snakes.

Preserved specimens of the different kinds of snakes may be shown if available : also pictures and skeletons of snakes.

The object of giving a lesson on snakes is to enable the pupils to recognise the common snakes so that they may know which are poisonous and which are non-poisonous.

Show the children the dead specimens. Some children may be afraid to come near the dead snakes even though they are dead and preserved in spirit. Tell them that they are dead and cannot do any harm. The lesson may be made interesting by seeking the help of a snake-charmer and asking him to bring some living snakes into the class. The children should be kept far away from the living snakes even in the presence of the charmer.

The children might have seen snakes. They recognise them immediately and run away. Lead them to talk about the food of snakes. They feed upon rats, squirrels, frogs, lizards, birds' eggs and so on. It is not possible to show a snake swallowing its food. Tell them the snake's mouth is large and its swallows its food slowly.

Ask them where snakes are found. They are found in bushes and jungles and in aloe and cactus hedges. Direct their attention to the colouring of the snakes which harmonises with the surroundings, making them indistinguishable to their enemies. Tell them that the kites catch snakes and eat them.

Let the children note how snakes are covered with scales and how they crawl wriggling their bodies. They have no legs.

Why are they so afraid of snakes? Their bite is so dangerous. Men rarely survive after snake-bite. Tell them that snakes do not bite men and animals wontonly, but as a defence. Unless we step on them or disturb them in some way, they do not bite us. When we disturb them they get afraid or angry and bite us. Also tell them that only some snakes are venomous and their bites dangerous. There are some snakes which are non-venomous and their bites are not harmful.

Show them the different kinds of snakes. The cobra, the krait and the viper are very poisonous. The charmer

Fig. 81. Cobras.

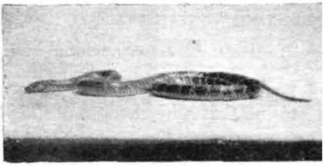

Fig. 82. Krait.

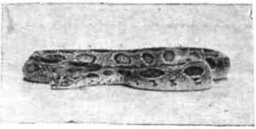

Fig. 83. Viper.

may be asked to show the poison fangs through which they inject the poison into our bodies: or this fang may clearly be seen on the skeleton. Snake-charmers pull out the poison fangs and then they handle the snakes freely. Tell the children that the best remedy for snake-bite is to blister the place or to make a cut in the place to allow free bleeding, so that the poison may run out with the blood and not circulate in the body. Potassium permanganate crystals may be rubbed into the wound. Put immediately a tight bandage above the bite to put a stop to circulation, as is commonly done in the case of scorpion stings.

The cobra is easily recognised by the hood and the spectacle-shaped mark on the back of the neck.

The krait is somewhat dark brown in colour, with white cross-wise markings on the body.

The Russell's viper has a broad, flat head with irregular white patches on the back.

The non-venomous snakes are the rat-snake, green tree-snake, the water-snake and the sand-snake. The sand-snake has a blunt tail, and snake-charmers commonly carry it about and exhibit it as a two-headed snake.

The rock-snake, a very large kind, is occasionally brought by beggars and charmers. This is non-venomous, but it coils itself round a goat or man and crushes the victim to death by the tremendous power of its muscles.

Though snakes may be useful in destroying rats and squirrels, they are dangerous. The snakes in the garden may be poisonous or non-poisonous. The best way to keep them away from us is to destroy aloe and cactus hedges and to see that other hedges are kept neat and clean.

The Frog—First lesson.

Take the children out to the pond or marshy place near by to show them the frogs. They know the frogs and can recognise them at once.

Catch a frog and ask the children to touch it. How does it feel? The frog's body is slippery, being coated with some slimy substance. Tell them that this substance protects the frog against the heat. If a frog is kept dry in a room for a long time it would die; it would not die if kept wrapped in a wet cloth. Therefore the frog is primarily a water-animal though it frequents the land. Tell them that the slimy substance helps the frog in slipping away from its enemies. Who are its enemies? The children have known some of its enemies already. Snakes, paddy-birds, crows, etc.

What does the frog feed upon? Why do frogs live in damp places? They live upon flies, insects and snails which are abundantly found in damp places. Tell them the frog can protrude its long, sticky tongue to catch insects.

Show them the eyes, which are prominent. Tell them the frog can see well and also hear well. At the slightest noise it jumps into the water and hides itself. How does it move on the ground? It hops along. The two hind legs are longer than the fore legs and this arrangement is useful for hopping. Show them the frog swimming. What does it do? It moves its hind legs only. Show them the webbed hind legs and how they are used for swimming.

When do they see frogs in large numbers? When do they hear the croaking of these frogs? In the rainy season and especially after it rains. There is a variety of frog called a toad which lives on land generally and which comes out at nights only. This is considered to be dangerous; but all frogs are harmless.

The Frog—Second lesson.

Take the children out to a pond or the water-trough in the school garden, where frogs are found. During the rainy months (November and December), you can find eggs and tadpoles. First find out where these are had and take the children to that place.

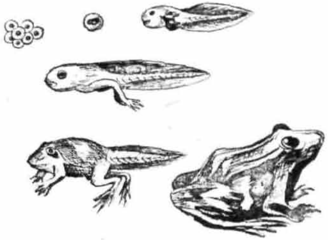

Fig. 84. Development of a frog.

Ask the children if they have seen young chickens coming out of the hen's eggs. The chickens are like the mother. The development of the young takes place within the egg. Tell them this is the case generally with birds and reptiles. Tell them to observe the development of the young frog. Draw their attention to the numerous eggs found floating on the water. They are small and look like boiled sago grains, being coated with a gelatinous substance. Let the children handle the eggs and tell you how they feel. Tell them that the parents concern themselves neither about the eggs nor about the young. So also with lizards and snakes.

It is not possible for the children to watch the different stages in the development of the frog as the development goes on. It takes a month or more for the full development. But you have the young frogs in the different stages before the children. You may tell them about the development and ask them to observe it for themselves later on.

Show them the tadpoles just hatched. After about four days, eggs hatch out to tadpoles by the heat of the sun. These tadpoles have long tails like fishes. They feed upon water weeds and very small insects, and grow. Now show them the tadpoles with the hind legs developed. Tell the children that this is the next stage. Then the fore-limbs

are developed. The tail gradually shrinks and finally disappears. The fish-like tadpole becomes a frog. The development of the young frog takes place outside the egg.

They have already seen that frogs frequent water and marshy places in search of food. They also lay their eggs in water. Even the toads which live on land lay their eggs in water.

Fishes—Two lessons.

Procure some living fish and keep them in a bell-jar or trough of water. Put some water-weeds in the jar or trough.

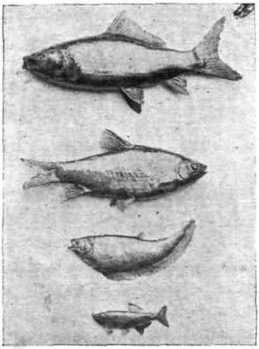

Fig. 85. Fishes.

Show the children the fish. Let them touch them. How do they feel? The body is slippery and cold. It is cold because it lives under water. What would happen if a fish were kept out of water for a long time? It would die. Have they seen any other animal with such a slippery body? The frog.

Tell them that fishes feed upon small insects found in water, and that large fishes eat small ones and their eggs. They eat also other things such as rice thrown into the water. Fishes make the water pure by eating rubbish and injurious insects in it. Some fishes eat the eggs and grubs of mosquitoes whose bites cause bad fevers. It would be well to introduce these fishes in wells and tanks near our dwellings.

Let the children observe the fish swimming in water. What enables them to swim? The fins and tail. They keep moving the fins and tail. Explain how the tail is used in turning. Do they keep swimming always? No, they rest suspended in the water. Let the children note that they are capable of floating at rest at any depth in the water.

Draw their attention to the constant movement of the mouth. It appears as if fishes are drinking water continuously. The water taken in is seen coming out at the sides of the neck. Tell them that they do not drink so much water. The air in the water taken in is breathed in by special arrangements and the water is let out through the slits at the sides.

Young fishes come out of eggs and live independently. The eggs are rarely seen.

Take the children to a place where men are fishing. With their help you may be able to show the boys some kinds of fishes. Explain to them the several ways of catching fish.

Ask them why men catch fishes. Men eat them. Tell them that some useful products, such as oil, are got from some kinds of fishes. Fish guano is a valuable manure.

Snails.

Show the children these curious-looking animals. What peculiarity do they note about them? They have shells on their backs in which they hide on the approach of danger. Touch the snail and demonstrate this.

When do they see snails crawling about in numbers? In rainy weather. Where do they hide at other times? They stick themselves under the leaves of plants, and in other places. Show the children some snails under leaves.

Tell them that snails generally feed upon decaying vegetable matter. They are of no value to us. Sometimes they feed upon fresh leaves also. Snails form the food of many birds. Ask the children to mention some birds which feed upon snails.

The Earthworm.

This is an interesting and useful little animal. You can see several earthworms moving on the surface of the ground after rain. Show the children these worms moving about and occasionally entering a hole.

Ask the children when they generally see these earthworms in numbers moving about. Do they see the worms always, at all times of the year? The children have observed these coming out after rain. Which other animals are associated with rain? They may suggest the snail, the frog, the dragon-fly and the winged termites. What do they understand from this? These animals love damp weather. Where do the earthworms live at other times? Have they noticed what are found when the soil is dug up or when the field is ploughed? These earthworms are found in the soil. They live in burrows or holes in the soil. Tell the children that they generally live in damp soil, and are rarely met with in dry and sandy soil.

Let them observe how the worm moves. It progresses by narrowing and stretching the forepart of its body and then shortening and drawing the hind part up to it. Its body is elongated and tubular, and appears to be made of a number of rings. Show them the bristle-like processes on the body which, like legs, aid in its locomotion.

Show them a worm burrowing into the soil. Tell them the worm will divide the loose soil with its mouth and burrow in. Show the children the small heaps of earth on the surface near the burrows. In this manner the earthworm carries the lower strata of the soil to the surface and loosens it, ploughing it like the farmer. Ask them why we dig up or plough lands. To loosen the soil and expose the lower soil to the sun and air. This the worm does, and so helps us. Call attention to the enormous number of worms in the soil and the considerable ploughing work done by them. These are really our friends.

What does it feed upon? Probably the children do not know. Tell them that the worm eats the decayed vegetable and animal substances in the soil. It takes up these substances together with the earth and assimilates the food matter and deposits back the earth in the form of castings. This earth is also loose and forms ploughed soil. At night it also drags down into the burrows fallen leaves and other half-decayed substances, which, after they have decayed, form a welcome food for it. Thus the worm is doubly useful to the farmers.

Chapter 8.—INSECTS.

The Butterfly.

Procure a butterfly net and two small bottles. Get specimens of preserved butterflies and moths from the school museum, also a fly, a beetle, a grasshopper and other insects.

Take the children out to a neighbouring hedge or a flower garden. The school garden too may serve the purpose. Butterflies are seen visiting the flowers in the morning and afternoon in the sunshine.

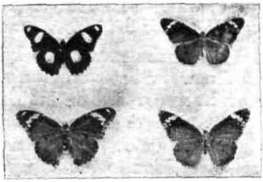

Fig. 86. Butterflies.

Show the children the several beautiful butterflies flying about in the air. How attractive they are! Are they all alike? Elicit that there are different kinds of butterflies; some have yellowish dots, some red and some are white or yellowish-white, and so on. What do they do? They fly about and frequently visit flowers for a little while. Why do they visit the flowers? If the children do not know the answer, tell them that they suck the honey in the flowers. Catch a few butterflies. Let the children see them and handle them carefully. Show them the mouth parts. At first the children do not see the long proboscis. Carefully uncoil with a pin the tube-like proboscis. Ask the children what purpose it can serve. This is tube-like, and the insect sucks the honey through this tube. How is the tube ordinarily? It is kept coiled so that we are unable to see it when we look at the butterfly casually. The insect protrudes the proboscis into the flower, and thus reaches the bottom part of the flower where honey is stored.

Show them the antennae or feelers, and the club-shaped extremities of the feelers. Tell them that by means of these feelers it can smell things and find out where honey is to be found. Show them the eyes. They are large and globular.

Tell the children that the insect can see well the flowers and other things.

Show them the butterfly resting. How are the wings of the butterfly while resting or sitting? The wings are folded vertically. Tell them that this is a characteristic of all butterflies. There are similar insects called moths, with wings, which sit with their wings spread. Thus they can distinguish between a butterfly and a moth. Show them some moths. Have they seen moths before? They might have seen some at home flying near their lights and occasionally sitting on books, dress and things of that sort. Tell them the moths are nocturnal in habits whereas butterflies are diurnal.

How many wings has the butterfly? Let the children count and tell you. Two pairs of wings. Let them touch the wings and feel them. What do they notice? The wings are smooth, and are covered on both sides with a kind of dust. Tell them that this dust really consists of regularly arranged scales when seen under the microscope. Also these scales give the peculiar colour to the wings. Are the wings of all butterflies similar? They are differently coloured and differently shaped too.

How many main parts of the body are there in the butterfly? Let them observe and tell you. Three parts—the head, the chest and the abdomen. How many legs are there? Three pairs of legs. Tell the children that such a thing with three distinct divisions of the body and with three pairs of legs is called an *insect*. Show them the bee, the fly, the grasshopper, the ant, the beetle and the bug. Let them casually observe that these have each three pairs of legs. Therefore what would they call them? Insects. Tell them they would study about these later on. Some insects are winged and some not.

Show them a few eggs found on the leaves of plants. Let them suggest whose eggs these are. They are probably the eggs of a butterfly. On which side of the leaf are the eggs generally found? On the under side. Why does the butterfly lay the eggs on the underside? Let the children answer—as a protection from heat and rain and from enemies. How many eggs are there? Numerous.

Tell the children that the life of a butterfly is very short. It lays eggs and dies. Tell them that the butterfly develops from the egg in a wonderful way, about which they would learn later.

The Moth.

Get some moths from the school museum. To see moths, take the children to a paddy granary where small moths are found in large numbers. Moths are also seen in flower gardens very early in the mornings or very late in the evenings.

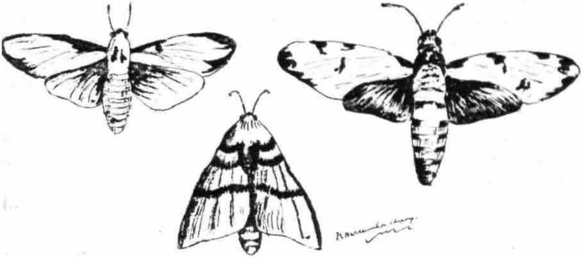

Fig. 87. Moths.

Show them the moths found, and those brought from the museum. Let the children note the different colours and sizes.

How many wings has a moth and how many legs? The moth has two pairs of wings and three pairs of legs. When are moths generally seen? They come out at night, and hence if children want to see moths in the garden, they should go to the garden very early in the morning or very late in the evening. Tell them that they go to the flowers at nights and feed on the honey. Show the long proboscis in the moth also.

Tell the children that the moth is also short-lived like the butterfly. The moth lays eggs and dies.

Moths and butterflies are of economic importance. They would learn later how they are useful and harmful.

The Life-history of a Butterfly.

Children should watch the gradual development from the egg to the butterfly. Get some eggs from the garden and breed them in cages. A small chalk box with one side fitted with glass or wire gauze would serve the purpose. A few holes may be made in the other sides to admit air into the box or breeding cage.

In a few days the eggs are not to be found there. Do they observe anything inside the box? Instead of eggs or butterflies there are a number of caterpillars. Tell the children that these caterpillars are hatched out of the eggs. If you had kept eggs from different plants, they would be probably eggs of different butterflies. Then the caterpillars also will be of different kinds. Show them how some are woolly, some hairy, and of different colours. Let the children observe them and find out if they have legs, eyes, etc. By questioning elicit from them that the caterpillars have three pairs of legs in the front, a mouth with jaws, and eyes. As the insect is long there are other legs to support the body in the hind part also. Let them count these. There are five pairs.

Ask them where they find caterpillars in the garden. They are found on the leaves of plants. What therefore do these feed upon? Show them the leaves eaten by them in the garden. They feed upon the leaves by biting and chewing them with their jaws. Tell them how enormously they eat, and explain what serious injury they cause to the crops in the garden and field.

Now take a few caterpillars from the garden and put these also in the breeding boxes. Supply them with food (green leaves) regularly every morning and evening, taking away the old and faded leaves from the box every time you put fresh leaves. Let the children watch them growing day by day. What do they note? The caterpillar grows bigger day by day, and casts its skin several times. After a few days the caterpillar has attained its full size. It then begins to hide itself. Let them watch what it does. It makes a little house or case and attaches it to the box (or to the plant in the case of those in the garden). Show them the different cases or houses made. Does it come out and feed? No. It rests inside.

Let them now watch these insects. Inside the house wonderful changes take place. After a few days the caterpillar becomes a butterfly like its parents, and when it is ready to come out it bites a hole or pushes open the door and creeps out. What a wonderful change! Explain that the changes took place inside its little house. What does it do immediately when it gets out? It sits in a corner flapping its wings as though it were having its first training in flying. Now let out one or two of these butterflies. They fly out quickly.

Such is the wonderful development of these beautiful butterflies, whose caterpillars cause us so much loss.

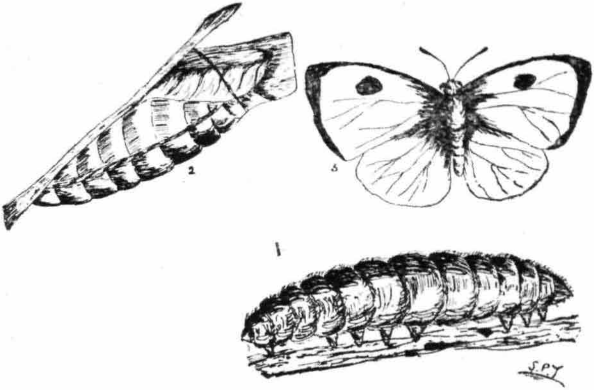

Fig. 88. Development of a butterfly.

Tell the children that the life of the butterfly is short. It lives for a few days feeding on honey and the juice of other parts of plants. Then it lays eggs and soon dies. These eggs produce caterpillars, which after feeding change into the sleeping stage and become butterflies.

It goes on in this way.

Life-history of a Moth.

The life-history of a moth is very similar to that of a butterfly. Question the children on the differences between a moth and a butterfly. Tell them they should watch the gradual development of the moth from the egg.

It is very difficult to get eggs of the moth. But when and where available, get a few eggs and caterpillars of the moth from plants and trees frequented by moths—trees such as the Udiyan, Country Almond, Elandai, etc., and put them in the breeding boxes. Let the children watch the development. (Very often the eggs and caterpillars procured are those of butterflies).

The moth lays a number of eggs and dies. After a few days the eggs hatch and caterpillars come out. Let the children compare these caterpillars with those of the butterfly. These also have three pairs of forelegs and five pairs of supporting hind legs. The colour of these caterpillars varies. In some moths the catterpillars have a horn-like process in the hind part of the body.

These caterpillars also feed upon leaves, casting or shedding their skins four or five times. So feed them with green leaves as in the case of the butterfly caterpillars. Then the insect makes or spins a web round itself. Let the children note the difference between this house and that of the butterfly caterpillar. This is silky in appearance, and is made of the thin, silky thread coming out of the mouth of the caterpillar. Inside this the insect takes rest. and after about ten or more days the perfect moth emerges. Such cocoons are sometimes available, and they may be preserved to watch the moth coming out.

Tell the children that it is the cocoon of the silk moth that provides us with the silk thread for our silk clothes. Explain to them how silkworms are reared in some places, e.g., Kollegal, and how the silk industry is carried on.

If by chance you have secured the eggs or caterpillars of different moths, you would have got different kinds of moths. Show them these. Show the children the preserved moths. Otherwise tell them there are different kinds of moths which vary in size and colour. But all have the same development and habits. The cocoons of a few moths only are useful. The caterpillars of some moths are dangerous crop pests, as they eat away the leaves and buds of plants.

Draw the attention of the children to birds that help us in destroying these caterpillars of moths and butterflies. Let them say which are the useful birds in this respect.

The Beetle.

Some preserved beetles may also be used for the lesson, besides living beetles.

Beetles are abundant everywhere. During rainy weather they generally come out in hundreds, especially in the evenings. In the daytime they hide themselves in cracks or holes in the earth. You have probably observed beetles flying near the lights at home. If you set up a lamp in an open space at

night, they will fly towards it and fall to the ground. You can then catch some easily.

Take the children out in the evening to a tope. Show them some beetles found there. Ask them if they have seen beetles before, and if so, when and where. By proper questioning elicit the following. Beetles are occasionally seen at home near lamps; they are generally found in topes and gardens; they are not usually seen in the daytime, but are seen in the mornings and evenings; they are more frequently seen in large numbers in the rainy season.

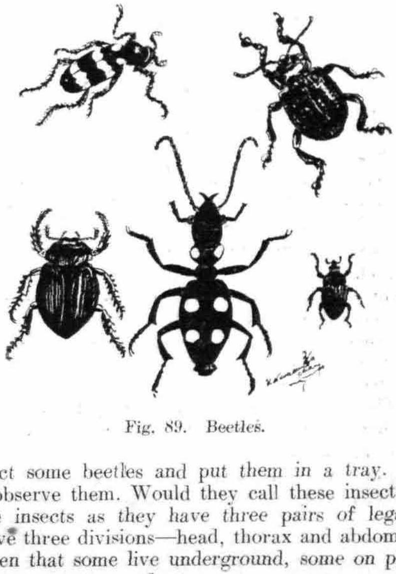

Fig. 89. Beetles.

Collect some beetles and put them in a tray. Let the children observe them. Would they call these insects? Why? These are insects as they have three pairs of legs. Their bodies have three divisions—head, thorax and abdomen. Tell the children that some live underground, some on plants and trees, some on water, and so on.

Call attention to beetles flying. Have they wings? How many? Use a pin and show the children the two pairs of wings. Ask them if the two pairs of wings are similar. No, the fore wings are horny plates, but the hind wings are delicate and transparent. The hind wings are larger than the fore wings, and are kept folded within the fore wings while at rest. Which wings does the beetle use for

flying? Evidently the hind wings only. Ask them what purpose the fore wings serve. They merely protect the delicate hind wings.

Let the children feel the body of the beetle. It is fairly thick-skinned, and is thus well protected.

Tell them about the food of beetles. They feed mostly upon leaves, tender shoots and roofs of plants and trees. They eat a great deal very rapidly, and as they usually come out in swarms they cause considerable damage to the crops. Show the children the eyes and the feelers. With the help of these they can find out where food is available. Some beetles live on dung and decayed matter. A few live on small insects.

Are all beetles alike? No. Some are big, some small, some spotted white or yellow, some brown in colour, some black, and so on. Show them specimens if available.

Tell the children that butterflies and moths are mostly harmless in their flying stage, but their caterpillars are bad. Most beetles are injurious pests both as adults and young ones or larvæ.

It should be possible to make a good collection of beetles for the school museum: also of butterflies and moths; indeed of all insects.

The Life-history of a Beetle.

Get some caterpillars of moths and butterflies for purposes of comparison with the larvæ of beetles.

It generally takes a long time to breed a beetle, and hence it is enough if the different stages in the development are shown to the children. Grubs of beetles are generally found in manure pits or on plants. Show the children, whenever available, some grubs. Tell them the beetle lays its eggs in the soil or on plants. After about two weeks these hatch out to grubs (corresponding to caterpillars), and these burrow in the soil. How are these grubs when compared to the caterpillars? These are somewhat larger and have a big head with mouth parts for biting. How many legs have the caterpillars? You may show them the insects with you. How many legs have these grubs? The grubs have three pairs of legs in the front, but the sucker feet are absent.

Tell the children that thousands of these grubs burrow beneath the surface and feed upon the roots of plants. They often destroy whole crops in this way. They eat hard and

grow rapidly for a short or long period without coming out of the earth. Then each one forms a case of its own, locks itself in, stays there during the sleeping stage and finally changes into a beetle. It then flies away to feed upon the plants it likes best.

You may probably find some beetles in the sleeping stage under the soil or inside the stems of some plants. If available, you can show them to the children.

Ask the children why beetles are generally more injurious than butterflies and moths. Beetles and their grubs largely feed upon plants and cause damage, but in the case of butterflies and moths, their caterpillars only cause damage.

Question the children on the ways provided in nature to get rid of these pests. Many birds eat these grubs and insects, and follow the plough in the field to catch the grubs and insects turned up to the surface. Let the children suggest which birds help us in this way. If it were not for these friends, these insects would probably never permit the growth of our crops.

Weevils.

Get a few grains of rice and cholam which have been stored for a long time. Some of the grains will be powdery matter with holes in them.

Show these grains to the children. Something should have eaten away the matter inside the grains. Let them find out what they are. They probably know that the grains have been attacked by insects. Show them some of the insects, which are easily found.

Fig. 90. A Weevil (enlarged).

Let them observe them. They are tiny little things less than $\frac{1}{8}''$ in size. Have they wings, legs, eyes, mouth and

other organs? They have all these and are insects. Tell them they are a kind of beetle but are smaller. Explain to them the large damage caused to the stored grains by these tiny insects.

Touch one of these insects. Let the children note what happens. It immediately tucks up its legs and feigns death. It does not move even if roughly handled. This is a means of protection against its enemies. Let the insect alone for a moment and it begins to walk again thinking the danger is past Let the children try this.

By careful questions elicit from them that these insects are dark or dark brown in colour, with two pairs of wings and three pairs of legs; as in the case of beetles the first pair of wings are hard and thick and are not used for flying, but they protect the other thin pair used for flying. Do they note anything characteristic about the heads? They have long, curved snouts with feelers. Once they have seen these snouts they would never forget these insects. Tell them these are called weevils or snouted beetles.

Show the children the grubs found in the grains. Tell them about the life-history which is similar to that of a beetle. The female insect bores a tiny hole through the grain with her snout and pushes a tiny egg in, usually one in each grain of rice, cholam, or wheat. The holes and eggs are so small that they cannot be seen by the naked eye. One insect will lay about a hundred eggs in as many grains, and from each egg will hatch out a tiny white grub. The grub eats away the food material inside the grain. Here it grows rapidly and hollows out the grain. It feeds for about a month, and goes to rest for about ten days in the grain. Then it changes into an insect similar to its parents. It then bores its way out, leaving a small round hole in the grain.

The weevils continue to multiply in this manner. One insect is able to produce in less than two months at least a hundred others. These hundred insects begin to lay eggs in more grains. So at the end of four months we may have one hundred times one hundred insects crawling about the godown. Thus they cause enormous damage to stored grains.

Tell the children that the weevils are mostly vegetable feeders, some living on plants, and others on dry seeds, wood, etc. Those feeding on living plants eat roots, stems, shoots flowers, fruits and also leaves and seeds.

Show the boring made by the mango weevil into the seed. Weevils are also found in the borings of the stems of cotton, amarantus, sugarcane, vegetables and so on. These are generally injurious to crops. Some weevils attacking plants are big. Show them specimens if available.

Other beetles very similar to weevils are also found attacking stored pulses, and are easily found in them. The characteristic holes bored by them may be noticed.

The Grasshopper.

These live in grassy lands and fields. As we walk along they leap out of the grass and probably fly in front of us. Some big grasshoppers are found on the madar plant.

Fig. 91. Grasshopper.

Show the children some grasshoppers. Let them note that some are large, some small, some green, some gray, and so on. These are different kinds of grasshoppers.

By proper questioning elicit from the children the following. The grasshopper has a comparatively long body, six spiny legs, large eyes, a mouth with jaws, and feelers. It has long wings; the wings in some extend beyond the end of the body; there are two pairs of wings, the upper pair overlapping the lower. The hind legs are longer and stronger than the forelegs. With the help of the long, strong hind legs, the insect jumps easily and far. Tell the children the insect makes use of its wings usually for long journeys.

Show the children some plants attacked by grasshoppers. Ask the children if the green colour is of any use to them. They often visit fields in swarms and destroy the crops. These are bad pests and should be driven out mercilessly. They eat up anything that is green, and leave nothing but bare stems behind them.

The Life-history of the Grasshopper.

The life-history of the grasshopper is interesting. You will find many young hoppers in the grass. Show them to the

children. Ask them if they note anything peculiar about them. They have no wings.

Grasshoppers lay their eggs in holes in the ground. The little creatures which come out of the eggs are not caterpillars or grubs, but young hoppers very much like the parents. At first they are generally of a greenish colour and have no wings. Ask the children if the green colour is of any use to be hoppers when they are unable to fly. They crawl and hop about eating tender grass and leaves. They eat and grow rapidly. They change coats often. After a time small wings appear and they become perfect grasshoppers.

Let the children note the difference between the development of the grasshopper and that of the butterfly or beetle. In the case of the grasshopper, there is no sleeping or pupa stage.

The Dragon-fly.

The lesson is best given when the insects are found flying about in numbers. You may take the children out to a river or pond-side, where dragon-flies generally live.

Fig. 92. Dragon-fly.

The children know dragon-flies well. They have probably caught a few and played with them. Show them the flies. Ask them if they are all alike. There are many kinds of dragon-flies. Some are large, others small, and many are brightly coloured. Let the children note the different colours in the flies. Some are red, some yellow and brown, some striped and some dark. But they are all alike in their growth and habits.

Let the children observe the dragon-fly. By careful questions, make the children describe its build. Its body is long, chest big and strong. Its wings are long, thin and transparent. Veins are seen in the wings and they are arranged like a net. The head is loosely jointed to the chest. The two eyes are so large that it looks as though the head consists of eyes alone. There are two short feelers, and strong jaws.

Where are they found largely? They are found near water. Let them watch what they do. The dragon-fly darts about and flies rapidly, skimming over water or the fields near by. Let the children see, if possible, how the dragon-fly catches a fly or a butterfly quickly with its forelegs, tears it to pieces and devours it. Occasionally it rests a while and then resumes flying. Is it a useful insect? Yes, for it destroys insects. Does it harm man? Do the children get injured when they catch it? No, it does not do any harm to man.

Tell the children that the fly has a peculiar development. The eggs are laid in water which hatch out after some time. After some weeks these young ones become perfect dragon-flies and fly out.

Bugs.

Procure some bed-bugs for purposes of comparison.

Take the children out to the garden and show them the bugs on the plants.

Ask them what they are. They might say they are some kind of insects or beetles. Let the children touch one or two of these beautiful looking insects and smell. What do they note? They recognise a very disagreeable smell with many of the plant bugs. Ask them if they have noticed a similar bad smell in the case of any other insect. They would at once tell you that the bed-bug emits such a smell. They could

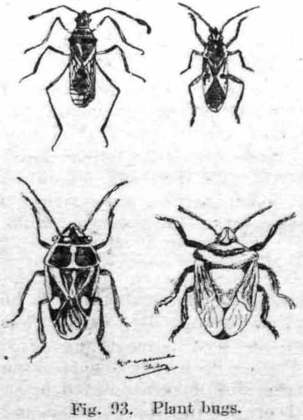

Fig. 93. Plant bugs.

never forget the smell after one experience. Now tell them that these are also bugs.

Is the bed-bug an insect? Can it fly? What does it feed upon? Let the children answer these questions. The bed-bug lies hidden in the daytime in crevices, and emerges at night and sucks the blood from our bodies. This feeds on animal juice. Have they wings? Can they fly? The bed-bug is an insect though it has no wings and cannot fly. It has three pairs of legs, the characteristic feature of all insects, and three parts of the body, the head, the chest and the abdomen.

Tell the children that these bugs feed on plant juice and destroy plants. Many have wings, but there are a few without wings. Some plant-bugs are large and others small. Turn the bug, and show the children the characteristic sucking tube projecting from the mouth. Tell the children that these bugs cause much trouble to plants, as the bed-bugs do to us.

These breed from eggs as other insects do. They must be destroyed.

The Honey-bee.

Show the children bees visiting flowers in the garden. They know the bees already. Ask them if they are insects. They visit flower after flower rapidly flying from one to the other. Why do they visit the flowers? Children probably know that they feed on honey. Tell them that they feed on honey and pollen. Talk to them about the beehive, and how honey is stored therein. Show them a hive if available. Why should the honey be stored? The boys probably do not know. Tell them something about the life-history of the bee. There is a queen in each hive and those bees which come out are workers. They build the hive with the wax secreted by them. The hive consists of several hexagonal cells; the queen bee lays an egg in each cell. The workers gather honey and pollen and store them in all the cells. Little grubs hatch out of the eggs and feed upon the stored food and then enter the pupa stage. After a few days they emerge as bees. Then they go out to other places, build hives and breed.

Let the children talk about taking the honey from the hives, and the precautions to be taken. The bees sting us sharply. Generally the bee after stinging a man dies, as it

leaves the sting (முள்ளு) in the body of the person stung. The bee does not die if it stings small insects.

Let them observe the body of the bee. It is hairy and brush-like. What do they find on its body when it comes out of the flower? Pollen powder adheres to the body, and this is carried to other flowers visited by the insect. Tell the children that the bee effects the pollination and fertilization of the flowers, and thus serves a very useful purpose. The children have already seen that the pollen must come in contact with the embryo fruit in the flower for the embryo to grow and become a mature fruit.

Have they heard of any enemy to the bee? They know the bee-eater bird catches and eats bees. Tell them that most birds do not attack the bee. But the honey-bee has other enemies. These are hornets and wasps, which belong to the bee tribe.

Ants.

Ants, like bees, are social insects, and they live in colonies. There are many kinds of ants well known to children. They come out to pilfer all sorts of sweet things in our houses.

Their industriousness is proverbial. They are always busy getting and storing food. They live in holes under the ground or in crevices of trees—and so on. The red ants, whose sting is so painful, construct nests of leaves on trees.

What do the ants feed upon? They feed upon vegetable matter, honey in flowers, and small dead animals. These are useful in a way, as they destroy some injurious insects.

Tell the children that the ants we see out are the workers, like the workers of the honey-bee. These have no wings. But occasionally winged ants are seen. These wings easily drop. There are different stages in the development of the ant—egg, maggot or grub, pupa and perfect ant. Tell the children that the small white things which the ants carry are often the pupa cases.

Termites or white ants are very destructive insects. They live also in societies, building underground cities for themselves, the upper parts of which we know as "ants hills". There are the workers and the queen. Show the children if possible the big queen ant inside. Sometimes winged white ants fly out in swarms, especially just before rain, and form good food for birds, bats, lizards, etc.

Other Insects.

(*a*) Harmful insects :—

(1) *The House-fly.*

Get a few living flies. Scatter some sugar on a paper and keep it on the floor. In a few minutes dozens of flies are found sitting on the paper. With a sweep of the hand you can catch several.

This dirty insect has only one pair of wings. It flies quickly and also runs quickly with its legs. The fly sits on all sorts of rubbish and comes and sits on our food also. It carries many germs on its hairy legs. Flies should therefore be mercilessly driven out. Tell the children never to expose eatables to flies and never to eat things on which flies have sat.

The fly deposits its eggs on dung heaps and decaying animal and vegetable matter. About twelve hours later larvæ creep out from the eggs and feed on the decayed vegetable matter. Show the children the numberless fly-maggots in old cow-dung at home. After a fortnight or so the grub enters the pupa stage. After a few days the fly comes out.

Tell the children if flies sit upon wounds in the body, they would deposit injurious germs in them, which would poison the blood and cause serious illness. Therefore it is necessary to protect wounds or any kind of broken skin from the unclean fly.

(2) *The Mosquito.*

This resembles the house-fly. The mosquito stings us at nights. Mosquitoes are nocturnal, whereas house-flies are diurnal. Tell the children that a kind of mosquito is the bearer of the malaria germ which by the sting of this mosquito is transferred to our blood. This causes the terrible malaria fever. We should protect ourselves from mosquito stings.

Tell the children the mosquito lays its eggs in water. The larvæ and pupæ live in water and come out after they have developed into perfect mosquitoes. Therefore by avoiding water stagnating in and around our dwelling houses we can keep mosquitoes from increasing. We should keep the drains clean, and often clean them with kerosine and water to prevent mosquitoes from breeding. The children have also learnt how fish can be used to prevent mosquitoes from breeding.

(3) *The Cockroach* is another troublesome insect making all our provisions unclean and nasty.

(4) *The Paper-fish* or the silver-fish is a wingless little insect covered with silvery scales like a fish. The abdomen ends in three long bristles. It is an inmate of our houses, and destroys paper, clothes and similar things.

Life-history of insects in general.

This lesson is a revision of the lessons done. By careful questioning all the facts should be got from the children and generalised.

Let them mention some of the insects they have studied—butterflies, moths, beetles, weevils, bees, ants, flies, bugs, grasshoppers, dragon-flies, etc. Which are useful and which are injurious insects? Butterflies, moths, bees are useful insects. But the larvæ of butterflies and moths, beetles, grasshoppers, termites, etc., are all injurious insects.

What did they notice regarding the life-history of insects in general? Insects pass through various changes of form, structure, habits, etc. Tell them these are the characteristics of the life-history of insects. Ask them to mention the stages in the development of insects—egg, caterpillar or grub, chrysalis, and imago or perfect insect. Do all insects have all the four stages? A few insects form exceptions. Let them mention the exceptions. The grasshopper and bugs have no pupa or chrysalis stage. Eggs of grasshoppers hatch out into young insects, which are similar to the parents but have no wings. Moults take place and the insects grow larger and wings appear. In bugs young ones hatch out of eggs. Do they know of animals whose young ones come directly out of eggs? Birds and reptiles. Is there any difference between the hatching of birds' eggs and the eggs of reptiles? The birds care for their eggs and young ones, but reptiles do not take care of their eggs and young ones. The eggs hatch by the sun's heat, and the young ones begin to feed at once independently. Do the insects look after their eggs and caterpillars or grubs? No. Only the social insects, as ants and bees, care for and look after their eggs, grubs and pupa.

What do they know about the larvæ-life of these insects? Eggs break and larvæ come out. They start feeding immediately. Feeding and growth are very rapid. Moults

occur as necessary. The larvæ life-period differs with insects—a few days with flies, a few weeks with moths and butterflies, and a few months with many beetles. Larvæ are mostly independent and feed themselves, but in the case of wasps and bees, the parent has to provide food for the young larvæ.

Then comes the pupa stage. The cocoons or cases are of different kinds. The period also differs with insects.

The last stage is the perfect insect or imago. The life varies with different insects. Egg-laying is the chief business in life with most insects. Some insects die after laying eggs, for example the moths. In moths and butterflies the life may occupy a few days and very rarely weeks. Bees and dragon-flies live longer.

Chapter 9.—NATURAL PHENOMENA.

Rain, the Sun and the Moon.

Rain—First lesson.

Select a rainy day for the lesson, as the children would be interested to see actually the phenomena they are talking about.

Enter into a conversation with the children about the weather, and the rain falling outside. Ask them if they like rainy days. Probably some do not like rainy days, and some like them. Ask them why they do not like wet weather. They cannot play outside, they cannot get out without umbrellas. If they get wet, they get cold and fever. Ask those who like rainy days why they like them. It is pleasant and cool and they enjoy the rain falling.

Ask the children about the uses of rain. It supplies us with water. Can we manage without water? No, we want water to drink, to bathe, to clean our clothes, to cook our food and so on. For everything water is necessary. Ask them what other things require water. Plants, trees and all animals require water. Call their attention to the enormous quantity of water required by plants and trees for their growth. Who supplies trees with water? Most trees depend upon rain-water; only a few are watered by men. Therefore rain is necessary for trees. Who supplies plants and shrubs with water? Wild plants depend upon rain. Garden and field plants and crops are regularly watered by us. They know

what trouble we take to water the plants in our school garden and what trouble their fathers take to water the field crops.

Let the children talk about the sources of water-supply in the case of garden and field crops. They are watered from wells, lakes or tanks and rivers—mostly wells in gardens and dry lands.

Ask them how the wells, lakes or tanks and rivers are fed. Where do they get water from? They get dry or partly dry in the hot months and they get filled up in rainy weather. Why? Because they get their supply from rain.

Tell them that rain is a very useful and necessary thing though we may not like rainy days. Of course we should not get ourselves wet in the rain. If we do so we may fall ill. When it rains we should protect ourselves with proper clothing and use umbrellas when we go out.

Rain—Second lesson.

Let the children watch the rain falling outside. Let them describe how it falls, as a light drizzle, shower or heavy downpour.

Dip your finger or a stick in a tumbler of water and take it out. What do they see hanging at the end? Water. Shake the finger or stick to allow the water to fall down. What is the shape of the water? It is a little round ball of water. Tell them it is a drop of water. Allow water to fall in drops from the finger or stick and let the children observe that the drops are all round. Now pour water gently from the tumbler or through a hole in a vessel. Let them describe how the water falls. It falls in a stream.

Now let them observe rain falling outside and describe how it falls. Does it fall in streams or drops? Rain falls in little, round balls or beads of water. Rain falls in drops. Ask them if the rain-drops are all similar in size, when it drizzles and when it showers. No. Rain drops vary in size. Small particles drop when it drizzles and big drops fall down when it rains heavily. This can be demonstrated by showing the children impressions of rain-drops on the soil or sand in the playground.

Take them out for a walk along the road after the rain ceases. What do they notice? Pools of water here and there and small streams running at the sides of the road. Ask them what becomes of the rain-water. Show them how it collects into small streams and runs along the lower places.

Show them how small streams join into big ones. Where do these big streams go to? They run along and discharge themselves into the pond, tank, lake or river near by. Explain to them now how tanks and lakes are fed in this way besides receiving the small quantity of rain-water falling on their surfaces. Rivers also are fed in this way by rain-water collecting into streams and many streams joining together.

Does all the rain-water get into tanks, lakes, or rivers? Show them a sandy place. Where is the water that fell on it? The place is dry. Has the water flowed away so quickly? No, the water has soaked in, and has gone underground. Which place allows water to soak in most readily—a sandy, clayey or rocky place? In a sandy place water soaks in readily; in a clayey place water is collected; in a rocky place water generally overflows, but some water gets underground through the crevices in rocks. Now ask them what becomes of the water which went underground. Explain to them how water is always circulating underground and how it comes out as springs in wells, and deep tanks and lakes. Well-water is always spring-water, coming from underneath. Thus rain feeds our wells.

What happens to the water stagnated in clayey places such as pools and ponds? Is the water there always? No. Where does the water go to then? It gets evaporated and disappears in the air. How does it get evaporated. By the heat of the sun. Recall to them how water kept in a vessel at home gets less and less by evaporation, how wet things get dry by the heat of the sun, and so on.

Rain—Third lesson.

Take this lesson also on a rainy day. Collect some rain-water in a vessel by placing it in the open yard or playground. Show the children this water. Point out that it is clear and not muddy, and tell them it is pure and good water which can be used for drinking purposes. But it is difficult to collect rain-water on a large scale and store it up for our use. Hence we use water stored naturally in wells, tanks and rivers.

Take them out after the rain ceases. Let them observe the streams formed by the rain. The water is dirty and muddy and has a reddish or brownish appearance. Put some of this water in a tumbler and let them observe it. What do they see in it? A lot of mud suspended in it. Is this water good? No, we can't use this for any purpose. Keep this water in a

vessel for some time. What do they notice? The suspended impurities have settled down and the water above is clear. Can we make this water clear in any other way? Yes, we can filter the water with a cloth or sand. Tell them that this water is not good for drinking purposes even after filtering, as it contains dissolved in it decayed vegetable and animal matter washed from the roads and surface of the ground, which is injurious to health. Similarly river-water, after rain, is muddy. It must be filtered and boiled well before drinking, as boiling will destroy the injurious effect of the decayed matter.

Let them observe how this mud or sediment gets mixed with the water. Show them how rain-water destroys roads and surfaces by cutting through them and carrying with it the mud and soil thus cut away. Explain to them the tremendous force of running water and how it damages surfaces if not well protected. Show them the deep channels made, and surfaces corroded by rain water. Explain to them how much more will be the effect of a river running through land. What amount of mud and sediment do rivers carry away!

Is this dirt and sediment which is carried away by running water of any use? Tel the children it is of much value as manure for plants and trees. Tell them how sediment from tanks and rivers is carted to the fields and gardens. Probably even in the school garden you have stored a few cart-loads from the neighbouring lake or river.

What becomes of the rain-water? Some is carried into rivers, tanks and lakes; a small quantity gets evaporated, and some sinks into the ground through sandy and porous places. The children know that it is this water that we get back in springs and wells. Question them about this spring water. It is clear and good; indeed the best water possible. How did this water get filtered and purified? The children would suggest that the sand filters the water and the water gets colourless and clear. How does the water in tanks and rivers get clear? When the water stands for some time, the sediment settles down and the water above becomes clear. This they have learnt before. Tell the children that well-water is better than river and tank water for our use.

Rain—Fourth lesson.

(*Rain and Clouds*).

Take the lesson when it rains. The children have learnt already how useful and necessary rain is to us.

Ask them where the rain is coming from. From the clouds. Where are these clouds? They are in the sky. How do they know there are clouds in the sky? The sky is dark or dark gray and they see the clouds moving in the sky. What is the colour of the sky at other times? Do they see clouds in the sky always? No, the sky is a beautiful blue generally. On many days the sky is quite clear with bright sunshine; on some days clouds are seen here and there. What difference do they note between the clouds they see now and the clouds they have seen on bright days? The clouds they see now are heaped up thick and close together covering the whole sky, and they are dark. On other days they see only patches of white clouds here and there. Have they seen the clouds in the morning at sunrise and in the evening at sunset? On some days clouds gather round the sun at sunrise and sunset, and they are thin and red owing to the sun's rays passing through them. Do they see the sun now? The clouds are so dense that they have completely shut out the sun. Encourage them to talk freely on these points. Can they know beforehand if it is going to rain? Certainly. Dark clouds appear in the sky and they gradually spread over the whole sky. Perhaps lightning and thunder come. There is a cold breeze coming up and they understand it is going to rain. People gather and remove all things put out to dry: children are let off from school early: cattle-boys drive the cattle home. Let the children describe such activities. All *of a sudden there is the downpour.* Then a *furious wind* comes, blows violently, breaking the twigs and branches of trees, sweeping dust off the streets, shutting the windows and doors. What happens? The clouds are scattered and carried away from the sky above us and the rain ceases. Ask them if wind has anything to do with rain. It has. The wind has to blow towards us from the cloudy part of the sky and then only it will bring the rain-bearing clouds to us. At the same time there should not be a strong wind to scatter the clouds and drive them away.

Are the clouds always of the same shape and size? No. They are always changing. Sometimes they are in little patches, sometimes in great masses like hills. They move about. Sometimes they move so very quickly that it appears they are chasing one another in the sky. What is the cause of all these changes? The wind.

Tell the children that sometimes there is heavy rain and strong wind with thunder and lightning, causing damage to trees and plants and even small houses. This is called a storm.

Rain—Fifth lesson.

You should have a small, simple rain-gauge in the school yard or in the centre of the school garden. Let the pedestal for the gauge be a little raised so that the rain falling on the surface around does not splash up and into the rain-gauge. Also see that the ground around the gauge is free from plants and trees, so that water may not drip into it from the leaves.

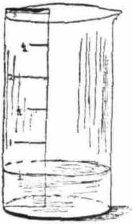

Fig. 94. A simple rain gauge.

A simple rain-gauge consisting of a cylindrical vessel, flat-bottomed, and with the same diametrical measurement throughout will suffice to measure the rainfall. If necessary, a funnel of the same diameter may be put over it so that the water collected may fall into the cylinder. This funnel will prevent much water evaporating: it will also keep birds from drinking the water collected. The rain may be measured by putting in an ordinary footrule and noting the depth of water. This height or depth gives the rainfall in inches.

Tell the children that they should have an idea of the amount of rainfall. If they do not know how rains is measured, tell them how it can be done with the aid of the rain-gauge. You should explain what one inch of rain means. This is very important. When rain falls, if in a certain space arrangements are made to see that no water evaporates, no water sinks into the ground, and no water is allowed to flow away, the depth of water collected in that space gives so many inches of rain. Describe to them how the ground will be muddy with less than one inch of rain, how it will have been washed clean after a heavy rain, how much water there would be in the village tank after so many inches of rain, and so on.

Thus make them realise by such practical examples what inches of rainfall mean roughly.

Take them out to the gauge after a rainfall. Let them guess how much rain has fallen. Then measure and show. Let them correct their estimates. Thus gradually let them be enabled roughly to estimate the amount of rainfall.

With their aid, maintain a rainfall chart in the school with the dates and amount of rainfall, the state of the sky as clear, lightly clouded, very cloudy, etc., and the direction of the wind.

Refer to the chart and give them the total rainfall for a few years. What is the average rainfall for your place? Explain to them how it is calculated.

Let them study the chart well and find out the rainy months. Let them study the distribution of rain in these months and the number of cloudy days in the year. Let them note the direction of wind in those months—north, south-west or west and north-east. Ask them which winds bring these rains. Explain how and why these winds bring clouds and rain. You need not touch upon the scientific explanation, but simply say that in April and May are thunderstorms and that during the other months the winds come over the sea and carry clouds or moisture with them. Also explain why Malabar gets much rain.

Wind.

Select a suitable day for the lesson when the wind is blowing strongly.

Take the children out for a walk. By careful questions lead them to describe what they see. Make them walk against the wind. What do they experience? They find it difficult to walk. Something is pushing them back. Their clothes are being blown about. Let them see the swaying trees and the dust blown up from the road, and hear the noise of the rustling leaves and creaking branches.

Where is the wind? Do they see it? No, they do not see the wind. Tell them that although they cannot see the wind itself, they can learn how the wind blows from its effects or actions, as they have just observed.

Do they feel the wind when they are inside the school room or at home? No. But do they know if the wind blows? How? They hear the noise outside and the rush of wind

through the door-holes making a whistling noise. Thus their ears tell them what their eyes cannot tell. They can hear the wind blowing; they can feel it, but they cannot see it.

Now, what can this wind be, which they feel and hear but yet they cannot see? Let them wave their hands quickly. Ask them if they feel anything as they move their hands about. They feel the air around them. Tell them of the air all around us. We cannot see it; we cannot hear it as we do the wind; we cannot even feel this air till we wave our hands about through it. But the air is always there. Tell them there is air everywhere we go. We could not live without air, and no animal or plant could live without air.

Let the children stand up and take a deep breath. What do they feel? They feel the air as it rushes in and out of their nostrils. Is the air in the room moving? No, it is still, and that is why we do not know it is here. How is the air outside? It is rushing along. Tell them that when the air moves about in that way, we call it wind. When the air moves about, we say the wind blows.

Does the wind blow always with the same force? It blows sometimes gently, sometimes strongly and sometimes very fiercely. Tie a kerchief to a pole outside. What does it do? It is blown in a certain direction. Similarly small pieces of paper thrown outside are carried away. Can they find out the direction of the wind from this? Yes, the wind blows or carries away these things in its direction. Let them note the direction of the wind then blowing. Tell them the wind does not blow in the same direction throughout the year. Refer to the chart maintained in the school, and tell them in general about the direction of the wind in the different months or seasons. Ask them occasionally to refer to the chart and learn more about the direction of the wind.

Is this wind of any use? Yes. They have already seen how it brings clouds and rain. Tell them that wind carries moisture also with it and our clothes get dry more quickly on a windy than on a calm day. The wind helps to make the surface of the ground dry after the rain.

Clouds, what they are made of.

The children are probably anxious to know what the clouds are made of. Tell them you will make a little cloud for them and then they will be able to see for themselves what a cloud is. Place a kettle or a narrow-mouthed

vessel of boiling water before the children. Let the water be kept boiling.

Call attention to the something coming out of the spout or mouth. What is it that comes out? What is it called? What colour is it? What is there inside the kettle or vessel? Steam comes out of the mouth from the water inside. Its colour is somewhat white. Tell them this is a little cloud. (Though what is really seen outside is condensed steam, steam being colourless and invisible, there is no harm in the children taking this for steam.) What has changed the water into this small cloud? The heat of the flame. Ask them how long will the steam rush out in small clouds like this. Till all the water in the vessel gets boiled away. What are necessary for cloud formation? Water and heat; water to be changed into steam by the heat. Tell them therefore that steam or cloud is only another form of water.

Show them a wet slate and put it in the sun. What do they see? The slate gets dry. Why? Because the water or moisture on the slate has been changed into steam by the heat of the sun. By careful observation the steam rising from the slate in thin, little clouds may be noticed. What do they learn from this? The sun's heat gradually changes water into steam or cloud. Tell them about the sun's great heat and its action on water everywhere, water in seas, lakes, rivers, tanks, etc. This is how all the clouds in the sky are formed. Ask them where clouds will be formed on a large scale, over land surfaces or over water surfaces as seas. Therefore winds coming from over seas bring clouds and rain.

Now take a cold slate and hold it over the steam as it comes out of the vessel. What do they see? They see water trickling down the slate. Where does the water come from? The steam coming out touches the cold surface of the slate and condenses into water. Tell them how steam is really water in a different form. What changed the steam into water? Cold. Tell them this is the case with clouds. When clouds get cold by coming into contact with a cold wind or otherwise, they change into water and fall down to the earth as rain-drops.

Call attention to the steam coming out of the funnels of railway engines. If we stand near the engine when the steam or clouds come out of the funnel, we feel the spray into which the steam is condensed. From the lids of cooking vessels at

home, we may see water trickling down. Let the children explain that this is due to the same phenomenon.

The children have experienced the mist found in the mornings or evenings during some months of the year. Can they explain what it is? It is really cloud on the surface of the earth. Mist high up in the sky is known as clouds. What becomes of the mist we see on the surface? It disappears with the sunrise. Why? The sun's heat converts this into steam and the steam rises up to form clouds. Tell them clouds are light and hence they float in air.

You may casually *mention about solid water or ice*, and how it is water which has become very cold or frozen.

The Sun and the Moon (1).

Take the children out to the garden to observe the growth of plants in general. Show them some plants growing in the shade. Ask them if they note anything about these plants. They do not grow well. They are whitish or yellowish in colour and they appear sick. You may also have some plants grown in pots in the school-room away from the sunshine. These plants also have not grown well.

Let the class suggest what this difference in growth is due to. Lack of sunshine or sunlight. What do they understand from this? That sunlight is necessary for plants. Tell them it is also necessary for us and other animals. What is the source of light? The sun.

Where do they see the sun? Does it shine always? Is it seen always in the same place? Do they see any difference in the size and colour of the sun during the day? How do they feel when the sun shines upon them? By putting such simple questions elicit from the children the following. The sun is a round, bright, white, ball-like thing in the sky. It is bright white generally, but at the time of rising and setting it appears a little bigger and is of an orange colour. It shines in the daytime only; in fact the name "day" is given to the period from sunrise to sunset. How dark and cheerless would we feel without the sun! The sun is the source of light and warmth. Does the sun appear every day? When is its warmth and light greatest and lowest in a day? Is the warmth the same throughout the year? No, the sunshine is very warm during some months. What do we call those months?

Thus let the children learn that the regularly appearing sun is highly useful to us by giving us light and warmth. This sunlight is necessary for plant growth also.

Elicit that some nights are dark and some bright. What gives us light at night? How is the moon? Is it as bright as the sun? Does the moon appear in the sky every day? Does it rise and set regularly as the sun does? Is the moon round always? Thus talk about the moon and its changing shape.

What other things do they see in the sky? The stars. When are the stars seen? How many stars are there? Can they count them? How do they shine? When do they see the stars well, in a dark night or in a moonlight night? Thus lead them to understand that the stars also give us some light which is useful during dark nights.

The Sun (2).

Tell the children that they are going to study a little more about the sun, the source of light and warmth.

By this time the children know about time and the number of hours in the day. Ask them how many hours constitute a day? Twenty-four hours. For how many hours is the sun visible? When does it rise usually? When does it set? At about 6 A.M. and 6 P.M. When is its light and warmth strongest? Why? Fix a pole in the school-yard or playground permanently. Draw four permanent lines showing the four cardinal points with the pole or rod in the centre. Let the children observe the shadow of the pole during the day.

Where is the shadow cast in the mornings? In which direction does the sun rise? How long is the shadow? How does the shadow vary in length as the sun rises up higher and higher in the sky? When is the shadow shortest, and why? The shadow is shortest at noon when the sun is vertically overhead. Then the warmth of the sun is greatest. The sun gradually gets lower in the sky and the shadow increases in length. In which direction is the shadow cast now? Why? Thus lead the children to understand the apparent daily movement of the sun in the sky. Teach them the cardinal points from the position of sunrise and sunset.

How is the soil at midday? The soil is hot. Do we water the plants at midday? The water will get warm and it may injure the roots of plants. Which is therefore the best time

for watering? Mornings or evenings (preferably evenings) when the sun's warmth is not great. Tell them also how seedlings cannot bear the great warmth of the sun at midday and how they have to be protected from it by being covered with green leaves or by being grown in shady places. But plants, after they grow up, require sunlight and have to be grown in places where sunlight falls.

Are the days and nights of the same duration throughout the year? Probably the children may not know about this. Recall to them practical experiences to show that the days and nights are not of the same duration. If the school is situated near the railway line or station, a train arriving there at 6 A.M. arrives on some days before sunrise and on some days after sunrise. But the train is always punctual to the hour according to the clock. It is the sun that rises earlier on some days and later on some days. Similarly a train arriving there at 6 P.M., arrives on some days before sunset and on some days after sunset. Boys coming to school at 10 A.M., find they have a long time at their disposal before going to school on some days, and on some days they find the time short and they have to hurry up their work at home. Elicit carefully that on those days when the sun rises early, it sets also late, and that on days when it rises late it sets early. Thus some days are longer and some days shorter, with corresponding shorter and longer nights.

Therefore the duration of days and nights is not exactly 12 hours all the year through. When are the days longer and when shorter? The children would probably answer this easily. Days are longer during the hot months and shorter during the cold months. Which months are they? Days are longer during May, June and July and shorter in November, December and January. Tell the children how this partly accounts for the greater and less warmth of the sun during these months. People have kept records of these, and the longest day is on the 22nd June and the shortest is on the 22nd December. On March 21st and September 23rd days and nights are equal. Give the corresponding vernacular dates and months.

The Sun (3).

Let the children observe the position of the sun at sunrise. Fix upon some tree or post due east and let the children

observe the position of the sun in relation to this tree or post. Does the sun rise opposite to this tree? It rises slightly to the north or south of the tree. Let them observe the shadow of the pole fixed in the school for this purpose. Where does the shadow fall? Does it fall exactly on the west line? When will the shadow fall to the north of the line and when to the south of the line? Take the case of a street in the village running east to west. Ask the children living in that street about sunlight falling on their pials. Some houses are facing north and some facing south. Elicit from them that the houses facing north have sunlight on their pials on some days in the year and the south-facing houses on other days. When do they have sun in the houses facing north and when in the houses facing south? If the school building is facing south, as it should be, these phenomena can be easily demonstrated. The houses facing south have sunlight on their pials in the cold months, when they find the warmth agreeable. In the houses facing north they have sunlight in the hot months and they find this troublesome. Which houses do they prefer? Why? Tell them that houses are most pleasant when they face the south.

Thus by appealing to them through common experiences and making them observe the shadow of the pole lead them step by step to understand that the sun does not rise in the same fixed position due east on the horizon. It has an apparent swing to the north and south of the east. Create an interest in such phenomena so that they may continue their observations about them. Tell them other facts to give a certain definiteness to the knowledge gained. Only on two days in the year, on March 21st and September 23rd, the sun appears due east and sets due west. From March 21st it gradually has the northward movement and reaches the northernmost limit on June 22nd, after which date it turns south, passing due east on September 23rd. It reaches the southernmost limit on December 22nd and then turns north. For six months from December 22nd it has the northward swing called the "Utharayanam" and for six months from June 22nd it has the southward swing called the "Dakshinayanam". Tell the children how the "Utharayanam" is considered generally auspicious for all purposes. Which are the marriage months? In which "ayanam" are those months? When do the two "ayanams" begin according to the Tamil months? The first of "Thai" and "Adi". Tell them how they are celebrated as festive

occasions. Why is the first of "Thai" considered more important? Which is the general harvest season for all grains, pulses, sugarcane, etc?

Thus correlate the phenomena of the sun, the English and vernacular months and dates connected with the phenomena, and the agricultural operations prevailing.

The Moon (2).

Converse with the children about the pleasant moonlight nights and how they enjoy them. Why is it they like the moonlight so much in preference to the sunlight? The moonlight is mild and cool and not scorching. There is a charm in a full moonlight night. Does the moon shine every day? Is it regular in its time of rise like the sun? Is the moon seen in the same place in the sky at a particular hour of the day like the sun? How many hours does the moon take to rise and set? Is the moon there in the sky in the daytime even if it is not visible? Why is it not visible in the day? Why are the stars not seen in the sky in the day? Are they there? Do we see the full moon on all days? On which night do we see the full moon? On which night do we not see the moon at all? How many days intervene between one full moon and another?

Thus question the children on the various phenomena of the moon, supplementing their answers wherever necessary, and lead them on to understand the phases of the moon and its repetition every 29 days. The moon also rises later and later day by day by about 50 minutes, thus rising with the sun on the new-moon day and setting with it, and rising at sunset on the full-moon day and setting at sunrise.

Talk to them of the bright fortnight and the dark fortnight, and the different days of the fortnights or "thithis". Let the children learn the "thithis". Tell them how people consider the bright fortnight auspicious, and within that period like to do such business as buying and selling, and agricultural operations such as ploughing, seed-sowing, etc.

Tell them that in the bright fortnight a few days are considered particularly auspicious and good for ploughing, seed-sowing, harvesting and other similar operations. Give them the days or "thithis," which are the 2nd, 3rd, 5th, 7th, 10th, and 13th days after the new moon.

Also tell them how Mondays, Wednesdays, Thursdays and Fridays are considered good or auspicious for such work.

A lesson on "eclipses" may be done when an eclipse occurs. Merely tell the children that lunar eclipses are caused by the shadow of the earth falling on the moon, and that solar eclipses are caused by the shadow of the moon falling on the sun. You need not tell them anything about the rotation of the earth or its revolution. It is important to remember that facts which cannot be demonstrated should not be taught to children.

PART II.—SCHOOL GARDENING.

CHAPTER 10.—THE SCHOOL GARDEN.

Ordinarily there is little scope for the selection of a site for a school garden: the teacher has to make the best of the site provided by the management. If this site is too small —as it usually is—the headmaster should be on the look-out for a site containing sufficient area for a garden, and should approach the management with a view to have this acquired as a school garden.

On page 167 are shown plans of school gardens. These *plans are only suggestive, as the arrangement of a school* garden depends upon the amount of land available for the purpose and upon the shape of the land. It will be noticed however that in all these plans, fruit trees are *arranged round the edge of the garden; as explained else*where in this book, the reason is that fruit trees should be kept apart from the garden plots, so that their roots may not extend into the plots and draw the plant food intended for the crops grown in the plots. It will also be noticed that the flowers are arranged as borders to the pupils' plots; this arrangement adds to the appearance of the garden. Needless to say, the manure and weed pits should be placed in the corners of the garden. Before laying out the garden the teacher should measure the ground available and prepare a plan showing how he intends to lay out the garden; this plan should provide as much space as possible for the pupils' plots, and the arrangement of the whole garden should be as artistic as possible. For this purpose the teacher should make a careful study of the plans on page 167. The plan prepared by the teacher should be hung on the walls of the school room.

In England it is the rule that each plot in a school garden, if worked by one boy, should be $5\frac{1}{2}$ sq. yds. in size, and this idea should be kept in view in elementary schools in Madras. In the plans shown on page 167 the size of each plot is given as $8\frac{1}{4}$ sq. yds., and this is intended to be worked by two boys. Where the space available does not admit of plots of this size being laid out for all the boys, the size of the plots should not be reduced, but a larger number of boys should be put to work on each plot.

In the plans on page 167 each plot is 12 feet long and 5 feet wide. The length should be approximately three times the width. This shape allows the pupils easy access to the plots. Pathways one foot to two feet wide should separate the plots.

The pupils' plots should be bordered with a line of flowers, and each set of pupils should attend to the flowers adjoining their own plot. In this line only annual flowers should be grown. Perennial flowers may suitably be grown in plots or in beds separated from the pupils' plots. In the spaces shown in the plans only small fruit trees like guavas, limes, pomegranates, custard apples, citrons, etc., should be grown: it is considered that the plot for these should be from 12 to 15 feet wide. A separate space must be kept apart for plantains, as their growth may interfere with the plot cultivation.

The experimental plot shown in the plan is for the use of the teacher. Here he will show how plots should be cultivated.

The necessity for a good water-supply in a school garden is obvious. In the plans the well is shown in the centre of the garden: perhaps the most suitable place for it is half inside and half outside the school compound, so that it is available for the use of the public.

The question of a fence for the school garden is one that needs much thought. It is obvious that if the garden is open to goats and other intruders, school gardening will be largely labour wasted. A goat-proof fence is absolutely essential. The best fence is a brick wall, but that is costly. A wire fence is also costly, and a fence consisting of wooden posts and wire is perhaps not much less costly. A good fence may be made of wooden posts 4 or 5 feet high, bamboo horizontals and bamboo, elandai and karuvelam thorns, provided that these thorns are closely packed and tied securely to the posts and horizontals. This kind of fence will, however, need to be frequently repaired, as gaps may easily be made in it. It is also combustible, and hence is not the best kind of fence.

Aloes, the common aloe and railway aloe, make a good fence, as they are not deep-rooted and hence do not interfere with the crops in the pupils' plots. But they have to be trimmed occasionally or they will spread. There is also the fear that they will harbour snakes. For the same reason cactus

should on no account be planted as a garden fence. In some places aloe hedges are common, and the teacher may prefer

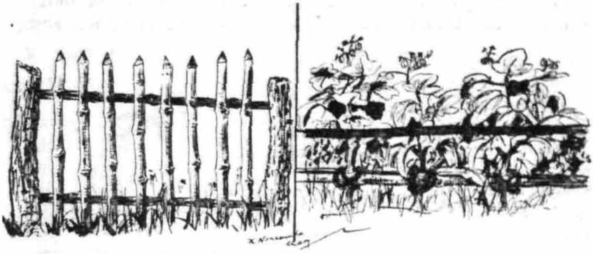

Fig. 95. Fencing.

With split bamboos. With jatropha plants.

to follow the local custom. In such cases aloes can be easily grown by planting bulbils or the underground runners.

The best kind of fence for the school garden is one made of Kiluvai or Jatropha. It should be planted thickly, for a thick hedge keeps out goats and cattle and also acts as a wind-break. Get cuttings 4 or 5 feet long and 3 to 5 inches round and plant these one foot deep in 3 rows about 6 inches apart. The cuttings should be watered and the line should be kept clear of weeds until the cuttings strike root. The fence needs to be trimmed occasionally and any gaps filled up. Jatropha is more common than Kiluvai, but it needs to be supported by bamboo cross-pieces.

In the assembly ground shown in the plans the pupils may be assembled to receive collective instruction on gardening operations. It may also be used for physical training The assembly ground is the least essential part of the school garden and the plots, and flower and fruit areas should not be reduced in number or size to provide an assembly ground.

The following tools and materials are necessary in a school garden. To turn the ground into clods and to dig pits crowbars are necessary: one large crowbar for the teacher and two small ones for the pupils should be sufficient Mamuties should be smaller than the ordinary mamuties, but larger than kalaikottu or hand hoes. One mamuti for every three plots should suffice. As many hand hoes as there are plots in the garden are required; also a sickle for every

three plots, and two or three cutting knives. A dozen small baskets for removing earth, manure, etc., should be supplied. Watering pots are also necessary. A wooden bucket, to which is attached a bamboo spout with a narrow slit across its grain at the far end, may easily be made, and may be used like a rose-can—the water flowing in a thin sprinkle. There should be a few big flower pots or boxes for raising valuable and delicate seedlings. Other flower pots—as many as possible—may be used for the cultivation of crotons and flowering plants. These may be kept in the garden or in the school verandah, and will add to the appearance of the place.

If space permits, a small tool-shed may be erected in a corner of the garden. The tools and other equipment should be arranged neatly in this shed. When the garden work is finished all tools should be cleaned by the pupils, oiled to prevent rust, and returned to the tool-shed.

Chapter 11.—PREPARATION OF THE SCHOOL GARDEN.

A garden is not ready-made. It has to be properly prepared for use, and this work of preparation is the duty of the teacher.

As has been suggested in the previous chapter, the teacher's first work is to measure the ground available for a garden, then to prepare carefully a plan showing how the ground is to be laid out, and then to peg out the various plots, areas and paths. In this work the pupils should co-operate.

The whole ground except the strips intended for paths and assembly ground (if any) should be dug up to the depth of a foot or so. This first digging may be too taxing for the children, and a cooly may be employed for the purpose. The clods should be left exposed to weather for about 15 days. At the same time pits should be dug for fruit trees and manure pits.

The ground has now to be levelled before the actual planting and sowing commence. At first the soil will need more manure than later on. The best soil is tank silt, and this should be carted to the garden. This tank silt should be applied at the rate of 50 cart loads to the acre, but where the soil is poor anything up to 200 cart loads to the

acre may be needed; the teacher should be able to calculate how much tank silt will be required for his garden.

At least one manure pit should be filled with manure ready for use. If the teacher is popular with the villagers he should be able to get the necessary manure from them.

The paths should now be made. Stones and gravel found when digging the plots should be used to build the paths, the gravel being placed over the stones. Ram the gravel well with earth in a damp condition, and the result will be even, firm paths. For proper drainage the paths should be higher than the plots, and should be slightly raised in the middle, thus giving a slope down to the plots.

It is usual to begin garden work in August, and the preparatory work might be done immediately after the midsummer holidays. If, however, this preparatory work is completed before the holidays, the real gardening work may be thus giving a slope down to the plots.

CHAPTER 12.—WORKING THE GARDEN.

The custom in England is that only boys of 11 years of age and over should do garden work; it is considered that boys younger than 11 years are not physically strong enough to handle the tools and implements for working the garden. As most of the elementary schools in the Madras Presidency do not contain classes higher than Standard V it is suggested that school gardening should be done by the pupils of Standards IV and V.

The idea is that each plot should be in charge of a pupil of Standard V, who should be responsible for the cultivation of the plants within that plot. He should be helped by a pupil of Standard IV, who having served an apprenticeship under the senior pupil will in time succeed to the control of a plot. It has already been suggested that if the space available for the garden is not sufficient to allow one full-sized plot for every two pupils, the size of the plot should not be reduced, but more than two pupils should be set to work on the plot.

A weekly forecast of work should be prepared by the teacher in collaboration with the pupils. Work in the garden will then be deliberate and systematic, and not haphazard.

In preparing this forecast the teacher should refer to the calendar given in chapter 13. This calendar is, however, a mere general statement and cannot be followed in all schools. In these matters local ryots are the best authorities, and the teacher should make it a point to consult them in regard to the dates and methods of the various operations in the garden. In this way the ryot may be brought into friendly connection with the school and may be led to take an interest in the work of the school. It is most desirable that the ryot should take a friendly interest in the work of the village school, and the teacher will have done well if he can bring about such co-operation.

It is most important that the pupil should be placed in a position of responsibility in relation to the garden. He should measure out his plot and draw up a plan of cultivating it, drawn to scale on paper. He should keep accounts of the cost of cultivating the garden—the cost of manuring, seeds, etc.—and all receipts from the sale of produce, and should draw up a balance-sheet showing the net cost of, or profit on, the garden. Apart from the pupil's responsibility in these matters school gardening should, wherever possible, be correlated with Arithmetic. Many opportunities will occur to the thinking teacher where gardening may be made an exercise in practical Arithmetic.

The pupil should also keep a careful diary of garden work. In this diary he should note the number of days taken for the plant to appear above ground after the planting of the seed, the daily progress of each plant, the number of days taken to produce flowers and fruits, insect attacks and diseases and the remedies applied, the application of water, any water scarcity, manuring, etc. He should compare his crop with the crops in the teacher's and other pupils' plots, and he should be encouraged to make drawings of the plant in its various stages. And as each crop is harvested, he should write a complete account of its cultivation as an exercise in composition.

The question of the disposal of the produce of the garden will have to be considered. The produce of a small garden will be of little value, but in a large garden it may be of some value. It is for the management to decide what should be done with this produce. On the one hand it might be sold, and the proceeds utilised to purchase seeds, manure, tools,

etc., for the garden. Or, to keep up his interest in garden work, the boy might be allowed to take home what he has grown in his own plot.

Chapter 13.—CALENDAR OF GARDEN WORK.

To enable the teacher to frame a programme of garden work for each month in the year, the following calendar is given. This is not intended to be followed everywhere in the Presidency. Seasons are not the same in all places, and it is for the teacher to discover for himself the proper seasons for the various operations in the garden, and to frame a yearly calendar suited to his particular school.

April—May.

Chittrai.

Irrigate standing crops of snake gourd, ladies' finger, cluster beans, chillies, brinjals, plantains. Chilli crop may be removed about the end of April. A brinjal crop may be planted if need be. Jasmine begins to flower, so too most other flower crops. Since this is the holiday time the village school might prefer a later crop of flowers, and the flower crops can be made to flower later if their irrigation be delayed.

May—June.

Vaikasi.

Irrigation: ploughing or digging fallow plots and carting manure. Turmeric and other root crops may be planted. In the root crops lines of agathi may be sown to provide shade for the crop; vegetables like brinjals, ladies' finger, cluster beans, snake gourds and bitter gourds may be planted, mixed with turmeric. Ribbed gourds and bottle gourds may be also planted in any convenient place with a view to stake them up so that they may grow up to a tree close by. Hoe standing crops. Plant backyard bean. Most of the annual flowers may also be sown for an early crop if desirable: otherwise sow in Ani.

June—July.

Ani.

Rains may begin. Sow chilli nurseries. Irrigate and choe standing crops. Plough and manure plots for chilli, etc., planting next month. Dig up the perennial fruit and flower garden plots or spaces round the standing plants. Annual flowers may now be sown if not done earlier.

July—August.

Adi.

Chillies are transplanted towards the end of the month. All Indian vegetables except the more delicate melons are planted in this month. Plantains are also planted now. This is the regular season to begin the cultivation of most plants. Flowers like the jasmine, rose, chrysanthemum, etc., are planted in Adi. Prune grape vines and manure them. Other fruit trees that require pruning should receive it early in Adi. Hoe and irrigate the standing crops. Stake up early-planted gourds and beans. Annual flowers are also sown and transplanted in this month if not done earlier. Radish may be planted now.

August--September.

Avani.

Chilli transplanting and planting of vegetables continue if not finished in the previous month. Hoe and water standing crops. Chilli crops if planted early may be hoed with mamauties; so too plantains. Stake up vince, beans, etc.: irrigate when necessary. Towards the close of the month regular crops of beans may generally be planted. Foreign vegetables and flowers may have their nurseries prepared. Some of them may be sown also. The hot weather is generally over now and the cold season melons or melons of a more delicate nature may be planted. Cold weather flowers prefer to be sown now. French beans can be planted. American cowpeas do best if sown now; but they may be sown almost at any time.

September—October.

Purattasi.

Irrigating standing crops and growing young ones and root crops. This is another season for planting chillies and brinjals. Foreign vegetables not planted in the last month may be planted now. Transplant foreign flowers and vegetables. Sweet potatoes and cold weather crops of onions may be sown in the nursery.

October—November.

Aippisi.

This is a season for vegetable planting. Plantains may be planted also in this month. Hoe young crops and irrigate all that require water. Onions may be transplanted or bulbs planted. Some people prefer to sow grams in Aippisi. All sorts of foreign leaves and vegetables must now be put in if not already done.

November—December.

Kartigai.

Much has not to be done except gathering vegetables before they get over-ripe, reserving those needed for seed. Irrigate when necessary and hoe crops when possible. Sow amarantus: this may however be sown in almost all seasons.

December—January.

Margali.

Chillies ought to get their fourth hoeing by the end of this month for the late Adi planting. Irrigate standing crops. Prune grape vines.

January—February.

Tai.

Sow brinjal seedlings. Hot weather crops of gourds, etc., are put in. Sweet potatoes and other root crops are due for harvest. Hoe and water crops when necessary. Irrigate and cover manure pits. This is the season specially suited for planting cucumbers.

February—March.

Masi.

Harvesting of chillies commences. Vegetables like brinjals, ladies' finger, cluster beans are sown or transplanted. Irrigate standing crops and hoe them when possible. Commence to sow a second crop of flower seeds. This is the regular season to begin the sowing of most vegetables that thrive in the hot weather. Bitter gourds and snake gourds are often sown in this month to provide for an off-season supply of vegetables. Sweet potatoes planted for nursery.

March—April.

Panguni.

Harvest turmeric, etc. Irrigate standing vegetable crops. Dig up all vacant plots. Stake up the gourds that require it. Dig up jasmine area and make beds and begin to irrigate them for an early crop of flowers. Procure necessary manures.

Chapter 14.—NURSERY FOR VEGETABLES AND FLOWERS.

Explain to the children that if little babies are to grow up strong and healthy, they must be carefully attended to and nursed when they are infants. It is for this reason that child welfare centres have been opened, where infants obtain the best attention. Similarly many plants are delicate when they are young, and, if they are to grow into strong and healthy plants, they must receive special attention; they must have the best soil, careful watering, the best manure, sufficient but not too much light—and so on. Such special attention cannot conveniently be given if the seeds are planted in the large area of the school garden. Therefore the seeds must be sown in a small space where they can be grown under the best conditions; and when they have grown strong and healthy and no longer in need of special attention, they can be moved or transplanted to the school garden.

The most convenient nursery for a school garden is one contained in pots or shallow boxes called seed-pans. Explain to the children that the seed-pan can be moved to a place out

of the way of the birds and ants, that it can be placed so that the tender seedling obtains just enough and not too much sunlight; and that a seed-pan is generally much easier to attend to than a larger garden plot.

Pots for the nursery should be from 6 to 8 inches deep and about 2 feet wide at the mouth. Wooden boxes such as kerosene oil cases may also be used.

For proper germination a seed must have moisture, air and heat. The pot should therefore be well drained; for this purpose two or three holes should be made at the bottom. To prevent the fine earth from blocking these holes and so preventing drainage, over each of these holes should be placed a piece of broken pot. Now place in the pot a layer of broken pot or pieces of brick to a depth of one inch or so, and over this a layer of coarse sand to a depth of one inch. Elicit from the children that the brick and sand provide the necessary drainage, and that the sand also prevents the soil above from passing through the brick and blocking the drainage holes. The pot should then be filled with a mixture of fine soil and well rotten leaf mould. After gently pressing down the soil it should be watered copiously through a water-can. It will then settle down and be ready for sowing.

If the method described above is not convenient, or if the school has a large garden, a small portion of the garden may be set apart as a nursery. The plot selected for the nursery should be in such a position that it is well exposed to the morning sun, but protected from the midday sun, as the tender seedlings, although they require sunlight for their growth, cannot withstand intense heat. It must also be well drained, and for this purpose it is better to make a raised bed. The nursery should be laid out in narrow beds, so that weeds may be removed and watering may be done without the beds being stepped upon and the seedlings injured.

The soil of the nursery must be carefully prepared and manured. All hard and gritty substance must be removed, and the soil should then be tilled. This tilling should not be very deep in a nursery, as deep tilling encourages the roots of the seedlings to go deep into the ground. The result will be that the roots are likely to break when the seedling is pulled up. On the other hand, if the tilling is not deep, the seedlings may be pulled up with the roots entire.

The nursery should be fairly well manured. If no manuring is done, the roots of the seedlings will have to go

in search of food over a large area; an elaborate root system will in this way be developed, and when the time comes for transplanting, it will be difficult to pull out the seedlings without damaging their roots. If, however, the nursery is fairly well manured, the roots will not have to wander far in search of food; their roots will be shorter, and the seedlings may be transplanted without damage to their roots. Leaf mould and tank silt are the best manures, provided that the tank silt is not clayey. Well rotten cattle-manure, although not so good, may also be applied, but care should be taken that it is well rotted before being used. Ashes may be used, especially when the nursery is in a damp situation.

Seeds should not be sown very deep. Small seeds should be sprinkled and lightly pressed in by the palm of the hand. Large seeds, such as beans and gourds, may be sown about one inch deep. It is important that the seeds should be sown thinly, so that when the seedlings come up there is from half an inch to one inch of space between one another. The seeds should then be covered by a thin layer of soil.

Seeds require darkness for their germination. The bed should therefore be covered with coconut fronds, thatties or something that does not touch the soil during the daytime, until the seedlings begin to appear. Immediately they begin to germinate, the bed should be exposed to the morning sun till about 10 a.m., when it should again be covered up. The covering should be removed at about 3 or 4 p.m.

The surface of the soil should be kept uniformly moist by gentle watering once a day. Immediately seeds begin to germinate they should be watered. Particular care should be taken about this. Water should be sprinkled evenly over the bed once a day. The proper time for watering is in the evening. Seedlings should on no account be watered when they are exposed to the sun.

To prevent ants from devouring the seeds and tender shoots, ashes should be strewn over the bed. This should be done after watering. It may be necessary to dust the bed with ashes almost every day for about a week or two after germination. If ants are very troublesome, ashes may be thrown round the bed or seed-pans, as ants do not usually pass through ashes. Where the nursery is contained in pots, the best plan is to place the pot over an inverted flower-pot. This flower-pot should be placed in a shallow seed-pan with the holes closed, and filled with water. The ants cannot get

across the water to reach the seeds. Sparrows may be kept off by covering the bed or pans with wire-netting.

When the seedlings have grown from 2 to 4 inches high they have to be planted out in other beds. Some time before they are transplanted the seedlings should be watered; this will loosen the soil and thus enable them to be pulled up without damaging the roots; the water taken in by the young plants will also enable them to meet the demands of the starvation period they have to face before the roots commence their functions in the soil to which they are transplanted. The pan containing the seedlings may also be shaken to loosen the soil. The best time for transplanting is on a rainy day and in the evening.

The clump of seedlings with the soil should be taken out with a flat bamboo stick. Each seedling should then be detached from the clump, care being taken that the root-fibres are not broken, and with the soil still clinging to the roots. Each seedling should then be planted in the second bed or pan. The soil around each seedling should be gently pressed. When the bed or pan is full it should be watered copiously, and as before regularly each evening. The seedlings should not be exposed to the sun for about three days; after this period they may be gradually exposed. In about 20 days they may crowd together; they should then again be transplanted still further apart. After about 1½ months it will be found that they are strong and hardy plants and ready for their final planting. They should then be planted singly in the beds arranged for them, or if the school has no garden, in pots. At each move the seedlings require fresh soil with additional manure.

While the transplanting of seedlings from pans or nurseries to the pupils' plots is convenient in a school garden, many varieties of vegetables and a few annual flowers may be sown broadcast. The plot in which the seeds are sown broadcast should be prepared in the same way as the seed-pan and nursery. When the seedlings have grown from 6 inches to 9 inches, all overcrowded seedlings should be pulled out, thus giving sufficient room for the plants that remain.

The above hints apply to vegetables and flowers. Hints on the planting of fruit trees are given on page 207.

CHAPTER 15.—WEEDS.

Any plant growing in the school garden in a place not intended for it is a weed. Thus a cotton plant growing in a plot or a row of brinjals is a weed. The weeds commonly found in a school garden are the various grasses such as hariali, nutgrass, chloris, and nerunji, mookaratai, etc.; all described in Part I of this book.

The teacher should clearly understand, and should also *make his pupils understand, that weeds are injurious in that* they grow at the expense of the crops: they take food from the soil which is intended for the crops, and they rob the plants of light and air.

The teacher should always be on the look-out for the appearance of weeds in the school garden, and should have them removed as soon as they appear, and thrown into the pit intended for the purpose and allowed to rot. Hardy weeds, such as grasses, do not rot quickly: they should therefore be given a sprinkling of quicklime which will cause these hardy weeds *to rot quickly. Weeds are best removed when young.* Deep-rooted weeds should be hoed out, care being taken that, as far as possible, no part of the weed or its root is left in the *ground.*

Weeds in a school garden look bad, and are the sure sign of an indifferent and careless teacher.

CHAPTER 16.—INSECT PESTS.

All plants are attacked by insects. Some eat the leaves or the flowers or suck the juices, while others bore inside the stem or roots or gnaw the bark. The damage done to plants in a school garden by insects may be serious. The pupils should therefore know something about insects and how to control them.

Part I of this book contains lessons on a number of insects and their life-histories. The pupils should therefore have no difficulty in recognising most of the insects found on plants in the school garden.

The pupils should be continually on the look-out for vegetables, fruits, flowers and trees eaten away by insects, and they should be taught how to deal with them.

Some of the insects that will be found in a school garden are :—

(1) Plant lice, usually found in the tender shoots of cow peas, lab-lab, etc. These suck the juice of the plants and cause them to dry up. They will be found attached to the green stem of the plant, and in such large numbers that they present the appearance of a dry twig.

(2) Mealy bugs, usually found on crotons, roses, brinjals, tomatoes, pine apple, mango, etc. They may be recognised by the white bloom on their bodies.

(3) Scale insects attached to the mango, guava, etc. These insects do not move about on the plants, but remain so still that they appear to be dead.

For the insect pests mentioned above, a tobacco decoction is the best remedy. One pound of tobacco should be boiled in one gallon of water for half an hour : in this dissolve about 4 ounces of soap. Let the mixture cool, and add six times its volume of water. It is then ready for use. This should be smeared on the affected parts of the plant by means of a broom or brush.

(4) Biting or eating insects, such as caterpillars, are those that bite off and eat the leaves of plants, such as the castor, melon, cucumber and other gourds, etc., gradually devouring the whole leaf. As there is no shortage of labour *in a school, hand-picking is the best remedy for these.* Let a boy or a set of boys be supplied with a coconut shell half filled with water and containing a few drops of kerosine oil as a film over the water. The pupils should pick off the insects by hand and drop them in the water.

Any badly affected plant should be uprooted and burned; otherwise the contagion may be conveyed to other plants. Similarly the parts of plants, if badly attacked by insects, should be destroyed.

The pupils should be taught how the rotation of crops *helps to prevent insects from increasing.* By *observation* in the garden, the pupils can learn for themselves that different kinds of insects require different kinds of plants for their food. If the same crop is grown continuously in the same plot, the insects feeding on that crop will always find their appropriate food ready for them. But if a different crop is grown, not suitable as their food, they will either strave or be forced to move elsewhere.

Clean cultivation of the school garden, the removal of weeds that harbour pests, the complete turning of the soil to expose the pupa of insects, are other remedies against insect pests.

The pupils should be taught carefully to discriminate between harmful and beneficial insects. They should encourage the later, e.g., mantis, dragon-fly, lizards and insect-eating birds.

As with weeds, the presence of insect pests in a school garden is the sign of an indifferent teacher.

Chapter 17.—THE SOIL.

In the training school the teacher will have learnt how the soil is formed, the constituents of the soil, and the different kinds of soil, with the characteristics of each kind. It is necessary that the pupil of the elementary school should have some elementary notions about the soil, so that he may be able to understand how to make the best use of the garden.

Place a lump of soil in a glass tumbler containing water. Stir the soil well into it and give it plenty of time to settle down. Let the children examine this carefully. Ask them what they see at the bottom of the tumbler. They should be able to recognise small stones and gravel. They should also be able to say that above this gravel there is coarse sand, and above this fine sand. At the very top there is a very fine sticky earth. Let the children take this in their fingers and say that it is sticky. Explain that this is clay, and that the coloration in the water is simply fine particles of clay which take a long time to settle down. But what is this between the clay and the fine sand? The children should pass this through their fingers and examine it. Elicit that it is not so sticky as clay, and that it is finer and smoother to the touch than fine sand. Tell them that this is called loam.

Take the children for a walk, and get specimens of different soils. Equal quantities of this should be placed in different tumblers containing water, well stirred and allowed to stand. Elicit from the children that one sort of soil contains a high proportion of sand, another a high proportion of clay, and so on. Such soils are called sandy soils, clayey soils, gravelly soils, etc.

Recall to the children that a soil containing almost equal proportions of sand and clay is called a loam. When the proportion of clay is high it is known as clayey loam and when the proportion of sand is high it is called a sandy loam.

Let the children get specimens of black cotton soil and red and light-coloured soils. After observing these soils pulverised in water, they will find that black cotton soil is generally a clayey loam, that is to say, it is a loam containing a high proportion of clay, and that red and light-coloured soils are loams containing varying proportions of sand.

What is the soil of the school garden?

Now dig a hole in the school garden down to the sub-soil, or take the children to a place where the soil has been dug away showing the sub-soil. Elicit that the soil is darker in colour than the sub-soil. Explain that the dark coloration is due to the presence of humus in the soil. Humus is decayed vegetable and animal matter and is very rich in plant-food. In colour it is dark-brown or blackish. All the cattle-dung added to the soil forms humus on rotting, and the roots and stubble of crops left in the soil produce it in the same way. The leaf mould used in the school garden is very rich in humus. The children will understand that a soil can only be fertile if it is rich in humus.

Now get a number of coconut shells and pierce holes in the bottom. Fill the first with sandy soil, the second with clayey soil, the third with sandy soil mixed with well rotten cowdung, the fourth with clayey soil mixed with well rotten cowdung, the fifth with a mixture of equal parts of sandy and clayey soils and the sixth, without a hole, with sandy soil. The quantity of soil in each shell should be fairly equal, and the quantities of cowdung added to numbers 3 and 4 should be equal. Mix the cowdung thoroughly with the soil. Place each shell on a stand of three stones. Let six pupils pour equal quantities of water into the shells simultaneously, and let the children note carefully when water begins to drip from the holes at the bottom of the shells. From their observations the following facts may be elicited from the pupils.

(1) The sandy soil is porous and does not retain water well. From this the pupils will readily understand that crops grown on a sandy soil tend to wither after rains, unless they are irrigated.

(2) Clayey soil retains moisture, and crops may be seen flourishing on clay in the dry weather, while on sandy soil

near by similar crops are withering. On the other hand, in the rainy season some clayey soils hold up so much water that they become waterlogged, and the crops grown on them suffer from too much moisture, and become rotten.

(3) Manure helps sandy soil to retain water, and makes clayey soils more porous so that the water may drain away.

From the above the children may be made to understand that the best kind of soil is that made up of sand and clay in almost equal proportions and containing humus. A good example of this kind of soil is to be found in tank silt, which improves the water-holding and crop-producing capacity of any soil. The children will have seen ryots carting silt to their fields in the summer when their animals are not otherwise occupied. Such tank silt makes an excellent soil for the school garden.

(4) Let the children note that the water is stagnating on the surface of the soil in No. 6, and that deep below the surface the soil has not been wetted. Explain to the pupils that the soil can take in water only if it is able to drain away this water below: that the soil must therefore be open at the bottom. From this the children will understand the necessity for tillage, that unless the soil is turned over from below it cannot take in the water necessary for the plants.

CHAPTER 18.—MANURES AND MANURING.

In the chapter on Soils it has been pointed out that the humus contained in manure is essential to the fertility of the soil, and in the sections dealing with the cultivation of each particular crop the manure appropriate to this crop is mentioned. In this chapter it will therefore suffice to revise the general principles of manuring and to give hints on the collection and preservation of manure in the school garden.

Elicit from the children that the plant, in order to grow, must take food from the soil. Let them suppose that plant-food is taken from the soil year after year without putting any plant-food in the soil. What will happen? The children will readily understand that the land will become poorer and poorer. The children know that the object of manuring is to supply plant-food to the soil. They will therefore understand that the land must be manured.

Explain to the children that well-made cattle manure is one of the best manures for building up the fertility of the soil. It opens up and lightens heavy clay soils, and on rotting supplies humus, which helps light porous soils to retain moisture. These facts the children have learnt in the lesson on Soils.

Horse dung is a good manure, but it is so strong that it has to be mixed with cattle manure before being applied. Sheep dung is an even better manure than cattle dung.

The manure most easily obtainable for the school garden is leaf mould, which may be made up of leaves, refuse from crops, clippings from plants, etc. And the children have already learnt that tank mud, or silt found in the beds of tanks, being of a fine clayey nature and containing a good deal of humus, is a valuable manure for sandy soils.

It is important that the children should know how to collect and preserve manure, for much waste is allowed to occur owing to the careless methods of cultivators.

Elicit from the pupils that when cattle manure is left in the open, it is apt to be washed away by the rain or blown away by the wind, and even that which remains loses much of its plant-food and becomes of less value as a manure. Explain that the practice followed by many ryots of leaving the cattle dung exposed in loose heaps is very wasteful. To make good manure we should prevent the heaps from being either too wet or too dry. This can be done by storing it in a covered pit, and keeping it slightly moist.

The manure pit should as far as possible be dug on level ground. The length and breadth will depend on the quantity of manure to be stored, but in depth it should be about 2½ feet, and from 6 to 9 feet square. Part of the earth dug out of the pit can be used for making an earthen bund all round, leaving a space to enable the pit to be entered. After completing the pit, spread a thin layer of straw or leaves over the bottom, and over this again a layer of about six inches of fine earth: this will absorb any liquid manure which would otherwise sink into the sub-soil and be lost. A cutcha grass roof should be used to prevent the manure from being over-dried by the heat of the sun, blown away by the wind, or washed away by the rain. If the manure is well pressed down from time to time, there is no fear of its getting too dry, as it is shaded by the roof from the direct rays of the sun. Around the manure pit may be

planted such crops as pine-apples, or any other shallow-rooted crop, which will hide its unsightly appearance, and at the same time will not send their roots into the manure pit.

The manure pit should receive cattle dung, leaves, refuse from crops, clippings from plants and the like. Nothing thorny should go into the manure pit, for thorns hurt the fingers. The best way of preparing leaf-mould manure is to have alternate layers of leaves, clippings, etc., to a depth of 6 inches or so, and layers of fine soil 1 or 2 inches deep. The whole should occasionally be moistened. Such a pit will be ready for use in about 8 months.

The garden should contain 3 manure pits, the first containing manure for the current use in the garden, the second with manure in process of rotting, and the third used to receive current refuse and leaves. It takes ordinarily from 10 to 12 months for vegetable matter to become thoroughly rotten, and the teacher should take early steps to fill two manure pits.

Besides the 3 manure pits, there should be a weed pit into which should be deposited all weeds, with their roots and seeds, found in the school-garden. Children will understand that there is a danger of weeds taking root in the manure pit and causing considerable trouble later on. It is therefore necessary that weeds should be placed in a separate pit and that quicklime should be added to hasten their rotting.

CHAPTER 19.—ROTATION OF CROPS.

In dealing with insect pests the children have learnt that the proper rotation of crops helps to destroy insect pests. Point out that different crops require different plant-food and in different proportions, and that what is left by one kind of plant may be useful to another kind; with the result that less manure is required for the second crop. Different crops affect the soil differently. One crop tends to exhaust the soil, another does not; an exhausting crop should therefore be followed by one less exhausting; for the same reason the plots in the school garden should always be well manured after root crops have been harvested, for root crops exhaust the soil. One crop encourages weeds; it should be followed by a crop that covers the ground and does not encourage weeds. By

pointing out these facts, the children can be led to an elementary notion of the principles underlying the rotation of crops, and that the crops of one kind should be followed by crops of a different kind.

In a large garden or field, the rotation of crops is possible. In a small school garden, where in each pupil's plot different kinds of plants have to be grown simultaneously, the proper rotation of crops is not so easy. To compensate for this lack of proper rotation, the children will understand that the school garden requires heavy manuring.

While rotation is not possible within one and the same plot, different plots of the school garden should, as far as possible, have crop rotations. A good general rule for crop rotation is that root crops should be followed by fruit crops. Thus ginger may be followed by brinjals and tomatoes, sweet potatoes by cow peas (short variety), onion by amarantus, radish by chillies, karanai by ladies' finger, and turmeric by cluster beans.

CHAPTER 20.—VEGETABLES—FRUIT CROPS.

Gourds.

The snake gourd, bitter gourd, ribbed gourd, bottle gourd, ash gourd, pumpkin, cucumber and melon are very familiar vegetables. To cultivate them the following methods may be adopted.

Make small pits or burrows about 2 feet in diameter and about 6 to 9 inches deep. They may be from 3 to 5 feet apart from centre to centre. The surface soil must be thrown separate from the bottom soil and the bottom of the pit left in clods. Let these pits remain exposed for some one or two months before planting. Just before planting throw back the top soil into the pit and mix it with leaf mould, and ashes if any. About 1 to $1\frac{1}{2}$ basketfuls of the mould powder should be added. Level the bottom of the pit and it is ready to receive the seeds. In the rainy weather monds at the same distance apart may be substituted for pits and burrows. Short ridges and furrows may also be made instead of monds or burrows. Let the soil be well prepared in any case. Most of the seed

and root crops may be planted in similarly prepared land. Before planting, the seeds, if they have a hard skin, should be soaked in water.

Snake gourd seeds have a tough skin. Therefore they may be soaked or even allowed to sprout with cowdung water before planting. If allowed to sprout before planting, the infertile and bad seeds may be discovered and discarded before they are planted in the pit. Soak the required seeds in a loosely tied cloth bag in cowdung water for a day or 18 hours. Remove the bag and hang it up in any dark corner of the house. The bag must be kept moist by watering it occasionally. In two or three days the radicle or small root shoots out, and the seeds must at once be planted. They have to be handled with care.

When the third or fourth leaf appears it is time to apply more manure. Sheep dung, pig dung and well rotten cattle-manure with ashes, all in a state of powder, may be applied at the roots and hoed in. Some more of the surface soil is now put back to cover it. Fowl dung, fish guano, oil cake manure, etc., may be applied in smaller quantities. If surface soil is not now available put in some more tank silt and leaf mould. In a heavy clay or poorer sand each pit may receive one additional basketful of the manure.

Stake up the plants when they appear to require support. They will show this by the tendrils moving about in the air as if to catch hold of anything they can get. It is best to provide them with a pandal made of twigs about 7 feet above ground. The advantages of this are that as the creepers spread on it the fruits which are particularly long can grow down. You can go about within the pandal to gather fruits or water the plants.

Watering should be done once in two or three days according to weather and soil conditions. Some people tie small stones to the free end of the fruits so that they may grow straight down and long, as they are drawn down by the weight of the stone. Excepting those meant for seeds all fruits must be collected before they attain full size. Fruits for seeds are gathered when ripened to a yellowish orange colour. The pulp enclosing the seeds is rubbed off with cowdung or ashes, and the seeds are dried and kept in a safe place. Some people prefer to mix the seeds with cowdung and make cakes of the mixture. These cakes are pasted on the walls.

Bitter gourds may be cultivated in the same way. But a pandal may not be very necessary. Branches of trees like the tamarind, etc., may be used to train up those plants.

Ribbed and bottle gourds are cultivated in the same way. As these will spread out over a larger area than the snake or bitter gourds, the best plan is to send them up trees. Otherwise have some big branches of trees of a pandal for them.

Ash gourds, pumpkins, melons and cucumbers also belong to the same variety of plants and may be cultivated similarly. They need not be staked up. Sufficient space must be allowed for them to spread on the ground. Twigs should be spread over the area for the vines to creep on as they do not do well when allowed to grow on the bare ground. Pits should be dug from 8 to 10 feet between alternate rows to provide space for the vines to creep about.

Generally speaking these plants grow fast and yield very fleshy fruits. They therefore require rich soil and an abundant supply of water. The manure that you apply to them must be well rotten so that the plants may absorb it quickly. Gourds are generally hot-weather crops but also thrive moderately well in the rains. But whenever you try any of the more delicate melons, especially the introduced ones, they have to be tried in the cold weather. Better plant them just when the rains commence and there is always a cloudy sky. Adopt the method of mond or ridge planting. The soil beneath must be stirred to about 8 inches to one foot. 3 to 6 basketfuls of a mixture of leaf mould and tank silt will be required for every 6 plants according to the fertility of the soil. Half a Madras measure of ashes in conjunction with the mixture will really benefit the crop.

Brinjal.

The brinjal is another familiar vegetable. The seeds may be sown in a broad-mouthed pot filled with well-manured soil. If pots are not available, small beds in the ground will do well. The soil in the beds must be prepared and manured well. Leaf mould and tank silt mixture will be the best manure. Two or three baskets per square yard will be enough according to the condition of the soil. Mix a Madras measure of ashes with the soil in order to keep out ants and other insects. Level the bed properly. Broadcast the seeds. Press the surface of the soil gently down by means of the palm of the

hand and sprinkle a layer of tank silt or fine earth to cover the seeds. Water with a rose-can if possible, or allow water to dribble down from a pot as you hold the mouth of it nearly closed with your hand. Watering should be done once a day. Do not expose the pot or beds to the sun until germination is complete.

Germination may be complete by the 4th to 6th day. Every seed should have come out as a plant by the 6th day. Watering should continue only as needed once in two days or so. Weeds, if any, should be removed carefully without disturbing or uprooting the young seedlings.

Make broad furrows 9″ × 3″ in section about 1½ to 2 feet apart from centre to centre, or beds one yard by two in area. Dig the soil in them to a depth of one foot and let the clods remain exposed for about two months. The seedlings will be ready for transplanting in about 30 to 40 days after sowing.

Again mix the soil in the beds or trenches with the mixture of leaf mould and tank silt, applying from 3 to 5 basketfuls per bed of 2 square yards. Apply a few Madras measures of ashes and mix them thoroughly with the soil. Now the trenches should be filled up, and the land is ready for planting. Seedlings have to be pulled out carefully; the higher grown, if any, should be removed for planting first. Make small burrows with the hand in the soil prepared for planting, and place one seedling in each of the burrows without folding the root: the roots should be buried underground with not more than an inch or two of the stem according to the height of the seedlings. These must be watered very copiously at once. Planting can be best done in the evenings as the following night will give the seedlings a better chance to strike roots quickly into the soil. If the planting be done in the morning, the noon sun which follows will affect the tender seedlings and weaken them. It would be better if the seedlings could be shaded from the sun by planting small leafy twigs near them. The leaves these twigs shed at the roots of the seedlings will first serve as mulch and later on as manure. Watering will have to be given almost daily till the seedlings strike their roots and put forth new leaves.

There is another method of planting. After manuring the plot well and thoroughly mixing the manure with the soil, ridges and furrows are made at 1½ to 2 feet apart. The seedlings are then planted on one side of these ridges. After some time when a second manuring has to be given, apply the manure

to the furrows close to the brinjal, line and split the ridges to cover the manure. The half ridges without plants is thus applied to the roots of the brinjal on the slope of the adjacent ridge—and so on, till all the brinjal plants are along the crest of the ridges so formed. Watering is now given in the furrows.

It will do considerable good to the crop, planted according to the first method, if manured a second time. A small quantity of ashes mixed with leaf mould will be the best. This will have to be hoed in well if the crop is in beds. Cattle manure is generally ploughed in for the first time and kolinji leaves are applied to the beds for the second manuring by some ryots. All the manures mentioned above for snake gourds are good for brinjals also.

The land must be kept free from weeds, and occasional hoeing will benefit the crop. One must be careful not to enter the crop or hoe the same when it is in flower. The first hoeing after the second manuring is generally done by means of mamuties.

Fruits must be gathered before they get old. As a vegetable they are much better and more valuable when tender. There are several varieties of brinjals, but they do not show much difference, except that the bigger-sized ones are less tasty and less prolific. The teacher can grow all the local varieties and also the imported ones. There is no difference in the method of cultivating the several varieties, except that the imported varieties are usually more delicate and require more attention. Brinjal is usually a very paying crop if there is a market close by. It will come up in almost any sort of soil, provided you manure and water the crop properly.

Chillies.

Chillies are cultivated much in the same way as brinjals. They are more productive when grown in red soils, and the fruits so produced are more pungent. Chillies do not require so much irrigation as brinjals. Therefore in a mixture of which the main crop is chillies, brinjals are planted nearer the water channels. Ladies' finger and cluster beans, which require less water than chillies, are grown on the ridges which make the beds. Chillies are often grown as a rain-fed crop, but this is not possible everywhere.

If the fruits are not required as green chillies, they may be allowed to ripen. When these red ripe chilli fruits are

dried, you get the chillies of the market. Brinjals are gathered when tender, but chillies are gathered at all stages of growth after the fruits attain their full size. Very tender ones are useless. If well-matured fruits are allowed to dry before they assume a red colour, the colour of the produce will not be so fine, and purchasers will not pay as much as they will for the ripe variety. When fruits are gathered, the green ones, or those with any green tinge, must be kept heaped up indoors for a day or so until they assume a uniform red colour. Then only put them out in the sun to dry.

Ladies' finger and cluster-beans are often mixed with either brinjals or chillies. They are also cultivated similarly, except that the seeds are planted directly into the garden, transplanting being unnecessary. Ladies' finger and cluster-bean fruits are gathered when they are tender.

Beans.

Beans are a set of plants that require different treatment for different varieties. Some are long duration crops, others have to be watered copiously. Some are creepers, while a few of them are shrubs. The one thing that is common in them is that they bear flowers that look like butterflies, and their fruits are legumes. They are generally cold-weather crops. They are recuperative crops and benefit the soil by fixing atmospheric nitrogen in it.

Lab-lab and red gram are two of this variety of crops. The ordinary lab-lab—mochai and the red gram are usually grown as purely rain-fed crops. The latter may be seen growing under slightly irrigated conditions, but not the former. As rain-fed crops they are mixtures with cholam, cambu and the like. In a vegetable garden they are seldom seen. Hence their cultivation methods are not described here.

The cluster bean is a popular Indian vegetable. Sometimes, but not often, it is grown as a dry crop in black cotton soils as a mixture with cereals, but it is best known as a vegetable. Mention has already been made of it under the head of chillies and other vegetables that are grown mixed with it. It is seldom grown as a pure crop.

Avarakai—Dolicos Lab-lab (Backyard bean) is the garden variety of avarakai. It is a very familiar vegetable in all households and is cultivated in the backyards of most houses. Hence it may best be called "the backyard bean" to differentiate it from the dry crop of lab-lab. A small pit

(burrow) or two of the crop will give a regular supply of green avarakai beans for several months.

Avarakai is planted in July in pits, like the snake gourd. These pits should receive one or two basketfuls of leaf mould and a similar quantity of tank silt up, and the seeds are then planted. When they have germinated and are growing well, a quantity of red earth or burnt earth is applied to them as manure. Poles are planted to stake them up to enable them to reach a pandal like the one already described for snake gourds. The crop has to be regularly irrigated every day, sometimes with cowdung water. A low mud reservoir is built up all round the plants to receive the irrigation water. The crop begins to yield when the cold weather sets in, say in October or November. From the month of May, when the vines are nearly exhausted, the irrigation water may be stopped and the plants allowed to wither. Some people prefer to top the vines in June. In the ordinary way the dry branches are removed in August, and irrigation and manuring are given after removing the soil round the roots. The space from which the old soil was taken thus gets filled up with good, garden soil and manure. By this treatment the vines soon begin to produce branches, flowers and fruits. Sometimes the vines are more prolific in the second year than in the first. Some plants may also die in the hot weather: in this case their retention for a second year is out of consideration.

The pods must be harvested when tender. Red flowers with purple pods and white flowers with green or whitish pods are some of the different varieties. But they all fetch a good price in the market. Therefore there is little to choose between them.

Cow peas are a variety with narrow long pods. These are either used as green vegetables or as dry gram. There are several varieties of cow peas. The best known are the ones with green pods. Purple-coloured pods and white pods are also seen. The last-mentioned variety produces the longest fruits, sometimes 10 or 12 inches long. In the other two varieties you have the short and long podded plants, but none attains the length of the white pod. In the green and purple varieties the pods are of varying thickness. Some American varieties introduced by the Agricultural Department into this country can be grown at any time: these produce fruits earlier than any local variety. They do not also trail along the ground to any distance, but remain a sort of bushy plant. All other

varieties of cow peas in the garden, especially the local ones, have to be staked up. However, in some cases farmers allow them to trail on the ground.

It may also be added that the bigger ones, which may be best-called cow peas, are garden crops, while the smaller ones known as cow gram are field crops. The seeds of all these varieties will make very good and valuable cattle food. The seeds of the bigger varieties may be sown as a mixture with cholam fodder to make the fodder more palatable.

Deep soil, well manured with silt or red earth and leaf mould, must be prepared for planting the seeds of cow peas. Plant in rows of shallow furrows, 2 feet apart, made for the purpose. When about a foot high, earth up the plants with a handful of ashes and leaf mould each, and irrigate between rows, thus making furrows. Stake up the plants before they begin to trail along the ground. It is better to hoe the plot after each irrigation whenever the crop permits of it. Remove some of the leaves if the plants are very leaf before flowering: in early rains they may be so. But when removing leaves take care not to shake down the flowers. Planting can be done in June—July till October. Short duration varieties yield green pods in about 45 to 50 days after planting. They continue to yield till the crop is 3 to 5½ months old. Pods may be gathered when tender if there is a ready sale for them. Otherwise let them get ripe and dry, when they may be gathered, shelled, dried and stored.

Cow-pea grains may best be stored in small gunny bags buried in paddy seeds. People sometimes keep them in the pods hung up above the fire-place. When kept mixed with ashes pests do not generally attack the seeds. They may be placed under a layer of sand in a vessel. Other methods of preserving seeds may not be possible for a village schoolmaster.

The sword bean is another familiar vegetable in this country. The plants are of stunted growth but produce pods about 2 feet long at times. These are a sort of giant bean with very big seeds. Prepare the land as for cow peas and plant the seeds from 3 to 4 feet apart. Staking may be done with one pole to keep the plant erect. Some of these plants have a tendency to grow too far: such should be trained up to trees. Ordinary varieties are stunted ones. Others are perennials: they require to be near some trees to trail up. Gather the pods when tender. Those meant for seed purposes should

be allowed to dry on the vines. They can be planted from April to June.

Goa beans or winged beans are an introduced variety. When tender they are very useful as a vegetable, like cow peas or sword beans. They can be grown just like cow peas, and must be staked up.

Peas are a cold-weather crop, and should be planted in well prepared and manured soil. Peas require to be planted deep: they also require a deep tilth, being very deep-rooted plants. Sowing can be done from the middle of October to November. The soil must receive liberal manuring. The seeds may be planted in double rows from 2½ to 5 feet apart, or just like cow peas. If the ground be moist when seeds are planted no watering need be given. Otherwise it is advisable to flood the area. When the plants are 4 to 5 inches high they have to be hoed, weeded and earthed up like any other crop. A little handful of ashes per plant just before hoeing or earthing up should be applied. The plants should then be staked up. The crop does not require as much water as ordinary vegetables. It requires watering about twice a week when pods are formed, and weeding as often as weeds appear. In gathering pods one should be very careful not to injure the vines.

Bone-meal is a very valuable manure for this crop, as also red earth. These two will, in fact, benefit any beans. A handful of meal for 4 plants will be ample if the bone-meal is a fine variety. Otherwise double the dose.

Peas are very useful in the dried state, and therefore the pods are allowed to get ripe on the vines themselves, and then gathered and dried.

Other varieties of beans are black gram, green gram, horse gram, etc. These are cultivated as purely rain-fed crops. However, they may find a place in a garden as a catch crop or as a green-manure crop.

The introduced varieties of beans are all cold-weather crops to be planted after August—September in well drained and very rich soils. The seeds may generally be planted on the crest or sides of ridges, as rains may otherwise stagnate water in the furrows and spoil them. Leaf mould is the best manure. Hoe as often as weeds appear. Irrigation may be needed twice or thrice a week according to the condition of the soil. These introduced beans should not be exposed to strong winds, which may shake down their flowers and also

agitate the plants too much. Also their branches are very succulent and brittle, and as such strong winds may damage them.

French beans can be cultivated in rows from 1 to 1½ feet apart, and about half a foot between plants in the row. These are very short, bushy plants, and do not at all require to be supported. These bushy plants are the dwarf variety of French beans. Other varieties, like the kidney and runner beans, are more difficult to grow in a school garden.

Velvet beans, butter beans, etc., are other varieties of introduced plants.

The teacher is advised to avoid cultivating any introduced plants until he is capable of producing good crops of local vegetables.

With this variety of plants let the boys make the following observations :—1. The shape of the seeds and the pods that contain them : the seeds have two cotyledons. 2. The leaves are mostly after the same pattern, except in the case of the peas. 3. The peculiar leaf structure of the peas and the long tendrils in which the leaves end are worth noting. 4. Try to find out the nodules on the roots of some of these plants. 5. Compare the flowers of one bean with the other and note their butterfly shape. 6. Find out the male and female parts of the flower and see that they are both in one, making a complete flower, so to speak. 7. Notice how insects enter them and come away one after the other.

CHAPTER 21.—VEGETABLES—ROOT CROPS.

Root crops are another class of vegetable. There are several varieties, but they are not as commonly used as the fruit crops. The great principle involved in their cultivation is that they require the soil to be kept open or loose for a longer time than any other crop, so that the roots may develop within it unchecked. They require considerable quantities of manure also, as they are generally heavy yielders of food products. A fruit crop that follows a root crop does well on account of the good tilth the land has received, and the residual effect of the large quantities of vegetable refuse added to the plot to keep the soil swollen, together with the sheddings of the root crop. Rotting Cambu straw is the best stuff to be added to the soil for this purpose.

Most root crops may be planted on ridges with furrows between them. The ridges may be about a foot and a half apart. Seed tubers or setts are then planted on the ridges. The important item of work afterwards, besides irrigation, is hoeing. Before the tubers or setts germinate there will be sufficient opportunity for the weeds to come up and cover the plot. This will practically spoil the crop. Therefore weeding should be done by scraping the ground carefully without injuring the sprouts of the crop.

Planting can be best done in April—May or May—June. The root development will then take place in about the rainy season, and harvesting will come off about January—February or earlier, according to the duration of the crop.

Colocasia, Karnai, and Elephant Foot Yam.

Colocasia, Karnai and Elephant Yam may be planted on ridges about 1 to 3 feet apart either way according to the variety. Signs of maturity are that the leaves turn yellow and the leaf stalks fall down. The crop may then be lifted. The central root of colocasia is not generally used for seed purposes by ryots, although it is found to do well as seed. One such tuber will give more than one seed, as it can be cut and planted if there be more than one eye on it. Elephant yams are planted like this, with a portion of the eye on the piece or sett. Each is cut into 2, 3 or 4 setts according to the size of the root. The side tubers are the best for both cooking and seed in both colocasias and karnais. Some people leave the crop in the ground until required for seed. If roots are kept in thick layers in a cool dark corner of a room they remain for a long time without getting spoiled. It is also good to have the tubers buried in dry sand in a room. This is perhaps the best way to preserve the seed tubers of most small-sized root crops. Elephant foot yams keep long when arranged in the cool corner of a room.

Onions and Garlic.

Onions and garlic are planted either in beds or on ridges. In the former they should be 6 inches apart either way, or $4\frac{1}{2}$ inches in very poor soil, but in the latter case the ridges should be about 9 inches apart, planting being done 6″ apart in rows. Onions require heavy manuring with well-rotten manure. The best method of manuring is that the manuring should be given to the previous crop and that the onion should get the residual

effect of it. Both onions and garlic require more frequent irrigation, more careful and thorough hoeing and weeding than any other root crops. Onion flowers have to be nipped off if the crop is intended to produce bulbs. Both these can be harvested when their leaves get yellowish and partly dried up.

The onion is cultivated both from bulbs and seeds. In the latter case the seeds have to be sown in a nursery about 35 to 45 days before planting. These can be planted from August to November, but October—November is the best season. The lifting of the crop comes off in the fourth month. The nursery has to be manured well with ashes. A good deal of sand or tank silt and sand mixed with the rich soil in the nursery would greatly help the growth of seedlings. These seeds should first be sown in a well-prepared seed bed, which should be made firm by pressing gently with the hand, and levelled. A layer of fine sand should then be strewn over the bed. Watering should be done very carefully by means of a rose-can. When the seeds are wet after watering they smell sweet and attract ants that carry them away. Ashes generally keep these out. However, take care not to have the nursery in a place infested with ants. A line of thick cow-dung water is often drawn all round the nursery bed to prevent ants from getting into it. It is better to sow the seeds in pots.

Radish.

Radish seeds may be planted on ridges 6 inches to a foot apart, from the beginning of August until November. Generally more seeds than necessary are put in, and the crop is thinned to the desired spacing. Seeds germinate within 3 days. The Indian varieties are pulled out for their roots in two months' time. Some of the English varieties do not take more than five weeks to produce roots fit to be eaten. These roots should be cleared of all the fibrous roots attached to them and the leaves cut close to the stem. One-third of the bottom portion of the root is also cut off and the stump is planted $1\frac{1}{2}''$ deep in very rich or well-manured soil and watered. These will then produce long stems with flowers and fruits.

The crop being of very short duration requires very heavy manuring and a good supply of water. A light kind of soil is best suited to its growth. If one requires a daily supply of these roots one has to sow every week or ten days. They can also be planted on the slopes of ridges, but on one side only.

Hoeing and earthing up should be done as in the case of brinjals, and the crop will then be in a line along the crest of the ridges so formed. The soil should be pretty deep, and well-manured with vegetable mould or pit manure from the school garden.

Tapioca.

Tapioca can best be grown in a fairly light and deep but heavily manured soil. Ridges and furrows are made in a well-ploughed and manured plot 2 to 2½ feet apart from centre to centre. These ridges must be fairly flat.

Tapioca setts are made by cutting the middle third of the stem into pieces 4″ to 6″ long. These are planted horizontally in the ridges at 2 to 2½ feet apart, with the soil just covering the setts. All the manuring is given beforehand, and watering should commence soon after planting. Germination may be complete in a month after planting. Within that time a weeding or two may be necessary. When the plants are partly grown they must be earthed up. No hoeing need be given after the plants shade the ground: hoeing might disturb the roots. It is this shade that keeps the weeds in check: thus it may be seen how want of sunlight affects even weeds. Lifting comes off about 8 to 10 months later.

Tapioca is a good vegetable. The root when sliced and dried will keep for a long time. It is powdered and made into conjee and taken as food by poor people in parts of the West Coast. Starch is taken out of it and prepared and sold as pearl tapioca and under a variety of other commercial names. When once it is made into starch it is easy enough to use it as food.

The brown-stemmed variety with red or pink leaf stalks is the best for ordinary purposes. Some of the varieties are highly poisonous, and their roots have to be boiled in water, which should be drained away once or twice, before they can be taken internally. It is better to avoid cultivating any poisonous variety.

Poisonous roots should be well crushed and mixed with water thoroughly. Strain the mixture through a fine cloth and let the liquid stand for some time, when the starch settles down at the bottom of the water, and the clear liquid above may be thrown away. This will make the starch perfectly safe and tasteless. This is the ordinary way to prepare starch from any root.

Sweet Potato.

The Sweet Potato is a crop of much shorter duration than tapioca, as it comes off in about 4 months' time. There are the entire-leafed and the palmate-leafed varieties. Cuttings 4 to 6 nodes long are planted to propagate the crop. In a well prepared field low ridges are made about a foot or a foot-and-a-half apart, and planting is done on them. Cuttings are sometimes planted in beds or small burrows when a nursery crop is required: but the disadvantage of this method is that creepers in beds grow too long, often at the expense of the roots. Cattle manure is always applied when cuttings are required. A root crop, especially sweet potato, becomes diseased when it receives a heavy dose of cattle manure. The best manure is village sweepings, leaf mould and ashes. Irrigation and hoeing or weeding are given according to the needs of the crop as determined by the climate and the soil. In some districts it is a common practice to turn the vines occasionally, as they may otherwise strike root in several places, thus reducing the size of the original root. It is better to do this once in a week or fortnight.

Diascoreas.

Diascoreas may be cultivated almost anywhere under irrigation. There are several varieties, but almost all are cultivated in the same way. They have all to be staked up, or sent up some big trees when they are long-stemmed ones. Vettilaivalli kizhangu is the variety most common.

Well-ploughed and manured land is made into shallow ridges about $1\frac{1}{2}$ to 3 feet apart, according to the size of the variety. The depth of tilth must not be less than 6 inches. Leaf mould or pit manure from a school garden is the best manure for this crop. Plant the setts or small tubers with well-developed eyes from a foot to 3 feet apart, and water the crop. A mulch of leaves or rotting leaves over these beds will be very beneficial. Weeding is very important, and hoeing, if any is done, should be shallow and done in the early stages. If the roots are found exposed on the ridges the plants must be earthed up. Watering can be given in furrows which are about 3 inches deep.

Different varieties require different periods of growth, but none is less than a six months' crop. In due course the leaves assume a yellowish colour or begin to get yellow dots on

them. The crop is then fit for harvesting, but may be allowed to remain in the field some more days till the vines are almost dried up. Some varieties produce small tubers on their vines. Such tubers are quite good for seed purposes, but are less valuable for food as a vegetable.

When lifted, the roots may be kept in a cool, shady and dry place till next planting season. If the place be warm and damp they may begin to sprout and waste their vigour.

Ginger, Turmeric and Arrowroot.

Ginger, Turmeric and Arrowroot may all be cultivated in the same way. But in the case of ginger the area should be kept covered by means of a layer of leaf mulch. They have to be planted in a well-prepared soil with a good deal of vegetable matter to keep it swollen. Cambu straw in a rotting condition is the best. Leaf mould is also very good. Village sweepings are the manure the ryots generally apply to this crop. Plough the manure up well with the soil. The depth of ploughing need not be more than 5 inches. Make narrow long beds about 2 inches high and about a foot wide at the top. The intervening furrows may be just a mamutie broad. Setts may be planted in two rows on the beds about 9 inches either way. Watering should be done in the furrows. As soon as the setts are planted it is better to mulch the crop, especially the ginger, and the mulch should be earthed up on the sides to prevent the leaves being blown away by the wind.

Irrigation and weeding should go on regularly. If the mulch is given, hand weeding will have to be done. If not, scrapings or shallow weedings will do well. Deep intercultivation is not advocated as it will affect the roots. For turmeric it is popularly said that there should be 7 hoeings and 70 waterings. It is a 7 months' crop.

Roots are lifted up and cleared when the leaves of the crop are partly dried up. Arrowroot leaves may not, however, fade soon unless you withhold water completely. Ginger can be sold as green ginger. Turmeric can be treated similarly, but curing may be done according to local practice by boiling it with water and drying. Arrowroot requiries to be crushed and starch prepared. The shoots of arrowroot with small bits of roots attached to them may be put back into a small pit and irrigated. This will give the necessary amount of seed suckers and rhizomes for the next planting season. Ginger

and turmeric *seeds* are preserved, mixed with sand and stored in a dry, cool, dark room.

Turmeric may be cultivated as the main crop of the root area, and ginger and other root crops and vegetables may be mixed with it as needed. Turmeric is a regular crop in some parts, and most other vegetables are grown with it as a mixture. Onions and maize mixed with it are harvested three months after planting. So too amaranthus. All other mixture crops are removed from the turmeric crop in Aipisi and a thorough hoeing and weeding is given. Ginger may, however, remain in the ground along with turmeric. Ginger when lifted has to be cured by drying the rhizomes after skinning and washing them. Ashes may not do much good to ginger and turmeric.

CHAPTER 22.—VEGETABLES—LEAF CROPS.

There are several leaf crops, known locally as Keerai or Amaranthus. These require to be sown in beds and thinned if intended as a stem crop, or allowed to remain thick and occasionally nipped when intended as purely a leaf crop. Some plants are, however, left in a corner of the bed to produce seeds, which will suffice to grow several beds of the crop in the following season. Well-manured land is reduced to a fine condition of tilth, and beds are made in it. The best manure is well-rotten cattle manure or leaf mould mixed with a little ashes; or ashes may be sprinkled when the plants have just sprouted. These leaf crops are very fast-growing plants and as such they require heavy manuring and watering.

Seeds should be deposited an inch apart in beds. Picking or nipping is done almost every week. In some cases when the plants are well manured they produce flowers which may be used for seeds.

Coriander, Cumin, Fenugreek, etc., are grown in some gardens as a green-leaf crop. Peppermint is also grown like this. Bigger varieties of amaranthus are sown here and there in a chilli or turmeric crop, and pulled out completely when fairly grown up, and used to prepare leaf curries.

Much attention has to be paid to leaf crops, as some of the leaf-eating insects might completely spoil the crop. Ashes are to be used, or hand picking must be resorted to. No

stomach poison should be used, as it will kill the man who cooks and eats the leaves.

CHAPTER 23.—PLANTAIN.

The plantain is cultivated both for its ripe and unripe fruits. Some varieties, such as bondan, are chiefly used as a vegetable, whereas others, such as poovan and rastali, are grown for the ripe fruits. Let trenches 3 to 4 feet broad and 4 feet deep be made. The bottom of the pits for about a foot and a half should be filled with cattle manure or night-soil mixed with equal quantities of good soil. Sheep dung is considered to be particularly good to force or hasten the crop. Leaf mould is also good. Ashes are commonly thrown in the ridges with plantains. Good suckers should be planted in the trenches 6 to 10 feet apart. The trenches should be irrigated so that there may be moisture always near the roots. During the rains the area round the plants should be dug up to allow free drainage of water. Not more than 3 to 4 stems should be allowed to remain in each cluster, and the other suckers should be removed and planted elsewhere. The stem that has borne fruit should be cut close to the ground and removed as it will not bear fruit again. A fresh sucker should be allowed to grow in its place. Thus a family may be allowed to remain for a period of 3 to 4 years in the place, when the suckers should be removed to an entirely new ground. As the suckers grow near the base of the stem of the mother-plant fresh soil should be gradually thrown into the pits or trenches so that the roots of the small suckers or plants may be well covered. Plantains are best planted in Adi or the middle of July, although they come up well in any part of the year, provided there is a good supply of water. The suckers to be planted should neither be too big nor too small. They should be kept for some time and the top cut off so that there may not be leaves on them. It is a bad practice to remove leaves from plants meant to produce fruits. Leaves may, however, be removed from the small sucker to some extent.

Chapter 24.—ENGLISH VEGETABLES.

English vegetables that can be cultivated in comparatively cool places are the cabbage, carrot, beet, turnip, lettuce, knolkhol, tomato, French beans and cauliflower.

All of them require well-manured, loose, loamy soil. They should be cultivated from August to December. They require watering very often to keep the soil moist. They can be forced with liquid manure. Cabbage, lettuce and cauliflower may, however, require a later season to form big leaves and buds, as rains may spoil them.

Carrot, beet, knolkhol and lettuce should be sown and not transplanted. Sowing should be done in lines 9″ apart. When the plants are 2 to 3 inches high they may be thinned out 9″ apart in lines. Cabbage seedlings also may be planted 9″ to 18″ apart either way, according to the variety, when the seedlings are 3 inches high. Bigger varieties of lettuce require to be planted 12 to 15″ apart both ways. Cabbage and lettuce, especially the latter, must not have their leaves wetted when you water them. This may spoil their leaves. When lettuce plants are large enough a few of them may be tied up every three or four days to whiten them. This should be done on a dry day lest the leaves should get rotten.

French beans and peas have been exhaustively dealt with in the section on beans.

Tomatoes may be sown in November. When the seedlings are about 6 inches to 8 inches in height they may be transplanted 2 to 3 feet apart either way. They should not be planted diagonally. A bamboo trellis work about 3 feet high has to be erected along each row and the plants may be tied up to this when they begin to fruit. The succulent branches may otherwise give way when the fruits become heavy on them. Tomatoes grow in almost all places.

Tomatoes are a very exhaustive crop and should be cultivated in well-manured land. Constant application of liquid manure, say twice a week, will not be too much for a good crop of tomatoes.

Cauliflower is probably the most delicate of all these vegetables. It is also the most valuable of all. The land must be very well drained to grow the crop successfully. Some of our oil cakes when powdered make the most suitable manure. About $\frac{1}{4}$ lb. per plant would not be too much. The nursery must be raised 6 inches above the ground. One ounce of seed

may be sown in about 50 sq. ft. When the seedlings are big enough to be pulled out they must be transplanted 4 inches apart into a more fertile bed. Next, when they have put forth two or three new leaves, they must be transplanted again 6" apart. Let them stand there till they are strong enough to be again transplanted, which may be when the sixth leaf is put forth in this nursery. They may now be transplanted just as cabbages, about a foot apart. These frequent transplantings will reduce the leaf production, and the ultimate flower produced will be bigger. It is the flower of this plant that is used for cooking.

These foreign vegetables do not produce good seeds in Madras. Hence it is necessary to obtain seeds from other places. However, tomato seeds can be obtained here from ripe fruits.

Note.—It is not intended that the teacher should start cultivating foreign vegetables at the very outset. Let him first be thorough with local and familiar ones and then pass on to less familiar plants. Lastly he may take up English vegetables if he is prepared to face a number of failures before successful crops are produced.

CHAPTER 25.—FLOWERS.

Plants that are cultivated for flowers can be classified into annuals and perennials, biennials being treated as annuals for practical purposes. Annuals are mostly grown from seeds, whereas perennials are reproduced from seeds and cuttings and by layering. There are other ways of vegetative reproduction, such as budding, grafting and marcottage, but the teacher need not study these methods, which are generally followed only by professional seedsmen and florists.

A mixture of leaf mould and cattle manure is the best manure for flower plants. Well-rotten horse dung and red soil are also good : red soil helps the flowers to colour beautifully.

Most of the annuals require transplanting from the nursery or thinning out if sown direct in the plot. It should be remembered that when flowers are allowed to dry on the plant, most of them form seeds, which process takes up a large part of the energy of the plant, thus stopping efficient blooming.

As soon as the flowers begin to fade they shoud be cut, excep: a few reserved for seeds.

Perennial flowers are useful flowers to have in a school garden, as they remain alive throughout the year. The seedlings are best grown in thumb pots or other small pots, and then transplanted into the garden. The seedlings, cuttings, layerings, etc., must be planted in well-manured deep soil: they must also have good tilth. The plants should receive occasional hoeing and weeding, as no plant can grow well if surrounded with weeds. Manuring should be done every year. The best manure is a mixture of leaf mould and silt, but red earth is also very good for most perennials: generally each square yard of ground should receive a basketful or two of manure. In a flower bed which has been in use some time the soil may have to be scooped out before the new soil and manure are applied. The plants should be watered regularly, fresh water being better than saline water. Some of the smaller plants may be grown in plots. This method is particularly suitable in schools which have no garden, or which have only a small garden.

The *Sunflower* is a very hardy annual flower-plant, and produces the biggest flower of the garden. It can be grown in almost all seasons of the year, but July to August is the best season. When the seedlings are 5 inches high they are ready for transplanting. The plants must be given wide spacing, as some of the varieties grow very big: 9 inches to 3 feet apart may be the range of spacing, according to the variety. Two main varieties are the red-flowered and the yellow-flowered ones. The latter is the bigger plant generally. All the varieties stand manuring well and come up very well in all well-drained soils. The seeds yield a sort of oil used in country lamps.

Zinnia has many varieties. All are hardly annuals. The plant is specially suitable for a school garden as its beautiful flowers grow throughout the year. These flowers are of different shades and hues. The seedlings can be best grown in pots and transplanted about 9″ apart in beds.

Hollyhock is not exactly an annual but a biennial. However, for all practical purposes it is grown as an annual. Sow it as soon as possible after the rains and thin the plants 6″ apart. It requires heavy manuring. A top dressing of well-rotten manure may be given when the flower buds are forming. Transplanting is not very successful with this plant. Care should be taken to burn any plant affected with fungus.

Cosmos is a fine short annual flowering plant that responds very well to manuring. In all seasons it comes up fairly well, but is best sown in October. Transplant or thin the plants about 6″ apart.

Balsam is well known as Kasithumbai. It grows almost always except in the very hot weather of April and May. June to September is the best sowing season. It is not a very hardy plant, and requires frequent watering. Being a small plant it can be grown successfully in pots. It should be transplanted from 4 to 6 inches apart.

Chrysanthemum is a common flower. There are the annual and perennial varieties. The annuals are raised by sowing seeds and the perennials by planting suckers, which must be transplanted every year to get a good yield of flowers. These may be planted in plots or ridges with a distance of 2 feet between each plant. If planted in August before the rains, the flowering will stop in February to March. During flowering, the plants should be watered almost daily. From March to August irrigation once a week is enough to keep the suckers alive for the next season. Seeds may be sown in October.

Marigold is a very familiar flower in an Indian garden. It is a very hardy plant and grows well in almost any season. It may be sown from June to November. It comes up well in all sorts of soils if given manure and water. There are the French and the African varieties. The former has flowers more or less like Zinnias with varying colours, while the latter are bigger plants, with lemon and orange hues predominating. It is better to transplant them in a school garden if there is a shortage of seed. If plenty of seeds are available they may be sown thickly in flower beds direct and the plants may be thinned out about 6 inches apart when 2 to 3 inches high.

Bachelor's Button is a very hardy plant. It does not require so much water as most other plants. Manuring improves it considerably, although it may come up well in poor soils as well. This may be cultivated in the same way as the marigold.

Vinca Rosea is another very hardy plant that can be kept on for a longer time than any other annual or biennial. It can best be cultivated by planting seedlings from 9 inches to 1½ feet apart. There are several varieties as indicated by the colour of the flowers, which varies from pure white to pink and crimson-red.

Mirabilis (4 o'clock plant) is for all practical purposes an annual, and is a hardy plant when once rooted. This is one of the most beautiful flower plants, and will certainly add to the appearance of the garden in the evenings when the flowers open. There are a number of varieties with various colours. It is best propagated by planting seeds in beds and thinning the growth later on if need be. Seeds can be sown in almost any season, but May, June or September and October may be considered to be the best time. Mirabilis is a fast-growing plant and branches profusely. Therefore the plants may be spaced about 9 to 10 inches apart either way. As the plants develop thick fleshy roots later on, they are able to withstand drought. A crop of mirabilis can be grown by planting pieces of these thick roots. Although the plant may apparently dry up during very hot weather if left alone, these fleshy roots underground remain alive and give off new shoots after a soaking rain or watering. Under irrigation the plants cannot be kept longer than one year, for by that time the stems get diseased. It is better to cut off the stems in case of disease and let the roots dry up for about two weeks. Irrigate the stump and you will soon get new shoots.

Gillardias are mostly perennials when grown on the hills, but in the plains they are best grown as annuals. They come up well in any soil, but red soil is the best. Small beds should be well prepared with manure and the seeds sown and watered. The seeds should be sown in October.

Dahlia can be grown from seed. Like all other small-seeded crops this requires a well-prepared nursery and watering by slow sprinkling. Thinning may be done from 9 inches to 1 foot apart when the seedlings are 2 inches high. In about 4 months they begin to flower. There are several varieties according to the colour of the flower.

Ipomea, *Passion Flower*, *Antigonon*, *Bougainvillea* and some varieties of Jasmine may be allowed to creep on trellis work or arches. The first three are mostly produced from seeds, and bougainvillea and jasmine from cuttings. Antigonon grows well on a trellis work to form a good hedge. These creepers which are allowed to grow on hedges or arches should be periodically trimmed. The cuttings or seeds should be planted in well-manured pits at the places where they are wanted to grow.

Rose and Jasmine (bushy) are raised from cuttings and by layering. The Rose may be grown in pots. Occasional digging

of the soil round the plants and addition of manure are necessary for proper growth. They have to be pruned periodically when the branches get too long and spreading. When the rose ceases to flower, the jasmine begins its turn, thus giving a supply of flowers throughout the year by turns. Rose and jasmine flowers are liked by all and are therefore very suitable for school gardens. They should be cultivated with care and attention. Red soil and horse-dung manure are particularly good for roses.

Well-grown branches are cut from the plant or shrub, and the two ends of the branch should be planted in the soil, making an arch. This should be irrigated well. After some time leaf buds will appear on the branch, and roots will be given off at both ends. After the buds have developed well the branch may be cut in the middle, and two cuttings are ready for planting. This is better than planting a mere cutting from the plant.

Layering is a more successful way. A long and well-grown branch is bent down to the ground or to a flower pot containing manured soil, and the middle part is placed in the soil, leaving the growing tip free. It is necessary to make a cut nearly to half the thickness of the stem on the underside of that part under the soil. This cut may be kept open by thrusting something into it. A stone or some other weight should be placed over the soil, covering the cut part of the stem so as to keep it in position under the ground. This should be well irrigated. After some weeks roots will be given off from the cut ends of the stem. The newly rooted stem may be severed from the mother plant, when it becomes an independent one. Rose and Jasmine may be successfully propagated in this manner. Good varieties of rose got by budding and grafting may be bought from florists. Budding and grafting may be tried by the teacher in the school garden if he has the taste and facilities.

Tabernœmontana (Nandyavattai) and *Tulsi* may be grown easily in the school garden. The former is raised from cuttings and by layering, and the latter from seeds.

Small trees such as *Bauhnia* (Mandarai), Cæsalpinia, *Tecoma stans* and *Thevetia nerifolia* may conveniently be grown in the school garden if space is available.

Chapter 26.—FRUIT TREES.

The cultivation of fruit trees requires much care and attention. A few common fruit trees such as lemon, lime, pomelo, guava and pomegranate may be grown in the school garden. If possible, a few coconut trees may be planted round the garden.

The site selected for fruit trees should be well exposed to the morning sun. The whole area may be well ploughed to a depth of about 2 feet, or 3 feet cubical pits may be dug at required distances. The pits should be exposed for a month or two. The bottom should be filled with boulders and sand to allow free drainage. The pits should then be filled with a mixture of fine soil and leaf mould. Then the soil in the pit may be lightly pressed in and a small hole made in the centre in which to put the baby fruit tree. After planting, the soil around should be pressed down. The plant should then be watered.

Just before planting, the roots should be examined and all large roots and bruised ones should be cut off. Rich manures should not be used when planting. Fine soil only should be around the roots of the young plant, which should be planted in such a way that the junction between the roots and the stem should be as nearly as possible on a level with the surface of the ground. Well-rotten cattle manure and bone ash may be used in the second year before the rains. Leaf mould is generally better than cattle manure for fruit trees, as the latter promotes the growth of foliage.

During the first three months after planting, the plant should be watered every alternate day. When the plant has developed new roots, irrigation once a week is enough. Probably no irrigation, except in summer, is necessary after it has grown to a tree. However, the amount of rain and the time of rainfall will determine the necessity for irrigation.

Pruning plays an important part in growing fruit trees. All dead wood and irregularly growing branches should be cut off. When cutting to a bud, no stump above the bud should be left, the cutting being close to the bud. When branches are removed, the wound should be dressed with a mixture of red earth and cow dung. The advantages of pruning are many. A tree which has been pruned to branch near the ground can be handled while pruning and picking fruits.

The growth of the branches and foliage is checked, thus aiding the growth of full-sized fruits.

Raising plants from seeds is rather difficult, and requires much skill and attention. The teacher will do well to get plants from nurserymen. If a baby-plant be purchased it may be cut to a height of 12 to 18 inches, taking care that a good bud is left on the stump. In a few days several short shoots will be sent up from the buds. Three or four of these shoots may be allowed to grow and the rest rubbed off. These shoots should be on the main stem in a symmetrical arrangement. During the first season these 3 or 4 shoots should be allowed to grow uniformly without interference, so that the root system may be well established.

In the second winter season these shoots will have developed into well-developed limbs. These should be cut down to 6 inches so that the dormant buds at the base may develop. At the beginning of the third season the baby-tree will have some 6 to 8 branches. With another pruning the tree will begin to grow symmetrically with a limited number of branches. Further pruning may be restricted to cutting off ill-growing branches and dead wood.

Fruits also should be thinned out to check the production of numerous weak fruits. A few healthy and full-sized fruits are better than numerous weak and very small fruits.

Heavy manuring should be applied to fruit trees only when they begin to bloom and not earlier. The space around the tree should be dug well before manuring so that the manure may get well incorporated with the soil. The manure should be applied 6 to 8 inches away from the stem all round the plant to keep off white ants. A small quantity of fine sand may be put around the stem to prevent white ants attacking it. The space should be irrigated after manuring. Night-soil, cattle manure, slaughter-house refuse, bone dust and wood ashes form good manures for fruit trees.

Fruit trees are subject to the attacks of insects and fungi, which may destroy the crops and kill the trees. These do not usually attack healthy trees but only the weak ones. Biting insects, such as caterpillars and beetles, may be driven off by spraying the affected plants with tobacco decoction or kerosine emulsion. A decoction of one pound of tobacco in 4 gallons of water will serve the purpose. A little soap solution may also be added. Kerosine emulsion is got by dissolving $\frac{1}{2}$ lb. of soap in a gallon of boiling water and churning this with a

gallon of kerosine oil till the mixture becomes milky. For use this may be diluted with 30 parts of water. To help us to keep off injurious insects there are also the natural friends of the cultivator; such as lizards, frogs, and birds which live upon these insects.

White ants are kept off by applying the following paint to the trunks of fruit trees :—Lime + 8 (kerosine) bottles; kerosine $\frac{3}{4}$ bottle, soap 4 lb., cow dung 4 bottles, turpentine $\frac{1}{4}$ bottle, water 4 gallons.

Sucking insects, such as bugs and plant-lice, may be driven off or killed by spraying kerosine emulsion or tobacco decoction.

Fungi pests such as rust, curl-leaf, etc., may be treated with kerosine emulsion or Bordeaux mixture. Bordeaux mixture is a solution of 1 lb. of blue stone, 1 lb. of lime and $\frac{3}{4}$ lb. of soap in 10 gallons of water.

Lemon, orange, lime and *pomelo* are all cultivated alike. They should be planted 12 feet or more apart. A mixture of leaf mould and ashes as a manure is better than leaf mould alone. Cattle manure should not be applied, as it unduly stimulates the leaf growth.

Guava is a very hardy tree, easily grown in any soil with a little attention. If properly manured, irrigated and pruned, the tree bears fine large fruits without many seeds. Guavas should be planted 15 to 20 feet apart.

Pomegranate is a hardy shrub like the guava and comes out well in any soil. The tree should be manured every year to yield good fruits. Pruning is essential. The shrubs may be planted 12 feet apart. An insect, a hairy caterpillar, bores into the rind and eats away the inner portion causing the fruit to decay. This is kept off by removing the calyx on the top of the fruit and tying the fruit loosely in a piece of cloth.

Papaya can be cultivated in the school garden. There should be a space of 10 to 12 feet between each tree. The tree thrives well in a rich porous soil. It begins to yield in 8 to 10 months' time and continues to bear fruits for 5 or 6 years, when it deteriorates.

Fig also thrives well in any soil. It should be planted 10 to 15 feet apart. This cannot stand much heat. It begins to bear fruit within one year, and plenty of manure and irrigation should be given during the bearing season. Occasional pruning should also be done.

Grapes thrive well in some districts such as Salem, Chittoor, Coimbatore, Bangalore, etc. They may be tried in the school garden. These are reproduced from cuttings and by layering. Pits 4 to 5 feet deep and 3 to 4 feet wide should be dug and well exposed to the sun for a few weeks. Bones should be placed at the bottom of the pits. They should be filled with soil mixed with oil cake, night-soil and sheep manure. The plants may be planted one in the middle of each pit. They should be watered once in two days. Copious irrigation should be given when the vines begin to bear fruits. When the fruits begin to ripen, irrigation should be stopped. A trellis work or pandal should be provided for the vines to spread over. In two years the vines begin to yield. In the cold season the soil around the roots should be removed and the roots exposed to the sun. Then the roots should be pruned and fresh manure and soil added to cover the roots. When pruning the branches or stems, the knife may be used freely to cut away everything, leaving only the stumps. These will put forth strong and vigorous shoots in the next season and yield good fruits.

Custard apple and *bullock's heart* may be grown in the school garden if possible. These are cultivated like the guava.

Coconut thrives well and fruits abundantly on the sea coast. Away from the sea coast it does not thrive so well as a general rule, and fruiting is less abundant. Deep sandy soil having perennial moisture below suits well. Though not to perfection the tree can be grown anywhere. Seedlings should be planted in July to August in pits 3 feet deep and 3 feet wide and 20 to 25 feet apart. Before planting, the soil in the pit should be mixed with sand, leaf mould and red earth. The whole of the nut should be buried in the soil, leaving only the shoot above the surface. For the first 2 years the plant should be irrigated and also protected from the glare of the sun. Every alternate year it should be manured with leaf mould and salt. Young plants or trees are often attacked by white ants. This can be avoided by keeping the soil moist. After 3 years the plant needs no irrigation. In summer they may be irrigated once a week. The common variety bears fruits in 10 to 12 years but the Ceylon variety bears fruits in 5 or 6 years. Dried and dead leaves should be removed and the crown kept clean for healthy growth. The coconut palm suffers from the attacks of rhinoceros beetles and palm weevils. These insects should be searched for periodically and destroyed.

Eugenia Jambolina, Jack, Cashewnut, Phyllanthus Distichus, Emblica and *Wood Apple* are some common fruit trees, but they cannot be conveniently grown in the school garden.

Mango.—This delicious fruit tree cannot ordinarily be successfully grown in the school garden. A tree or two may be tried if facilities permit.

Moringa.—The Moringa can be suitably grown in the school garden, as its leaves and fruits are in great demand in South Indian kitchens. Care should be taken that a good variety is selected for the school garden, and not a variety whose leaves are too bitter for use in the kitchen. The Moringa sends down strong roots, which may affect the growth of other plants in the garden. It should therefore be grown away from the garden plots. The Moringa may be raised from cuttings: but cuttings produce trees which will probably not be a good uniform shape, and which will be short-lived. A better method is to raise the tree from seedlings. A suitable spacing for the Moringa tree is from 10 to 12 feet.